9TH CLASS

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INTRODUCTION TO BIOLOGY

Major Concepts:

- 1.1 Introduction to biology
  - 1.1.1 Divisions and branches of biology
  - 1.1.2 Relationship of biology to other sciences
  - 1.1.3 Quran instructs to reveal the study of life
- 1.2 The levels of organization

1.1.1 DIVISIONS AND BRANCHES OF BIOLOGY

Q.1. How would you define biology and relate it with its major divisions.

Ans: BIOLOGY:

The word biology is derived from two Greek words i.e. "bios" meaning "life" and "logos" meaning "thought or reasoning". So, biology is the study of different aspects of living organisms.

Main Divisions of Biology:

There are three major divisions of biology which study the different aspects of the lives of these groups of organisms.

1 *ZOOLOGY:*

Zoology is the major division of biology which deals with the study of animals.

2 *BOTANY:*

Botany is a division of biology which deals with the study of plants.

3 *MICROBIOLOGY:*

Microbiology is a major division of biology which deals with the study of microorganisms such as bacteria, viruses, protozoa, etc. These microorganisms can only be seen under microscope.

Q.2. Write a ... branches of biology

Ans: Branches of Biology:

Biology is divided into a number of branches. In this way it is convenient to

study all the aspects of life. These branches are:

1. ***Morphology:***

   Morphology deals with the study of the structures and shapes of living organisms.

2. ***Anatomy:***

   The study of internal structure is called anatomy.

3. ***Histology:***

   Histology is the microscopic study of tissues and their functions.

4. ***Cell biology:***

   The study of the structures and functions of cells and cell organelles is called cell biology. This branch also deals with the study of cell division. It is also called cytology.

5. ***Physiology:***

   Physiology deals with the study of the functions of different parts of living organisms.

6. ***Genetics:***

   Genetics is the study of genes and their roles in inheritance. Inheritance means the transmission of characters from one generation to the other.

7. ***Embryology:***

   Embryology is the study of the development of an embryo to new individual.

8. ***Taxonomy:***

   Taxonomy is the study of the naming and classification of organisms into groups and subgroups.

9. ***Palaeontology:***

   Palaeontology is the study of fossils, which are the remains of extinct organisms.

10. ***Environmental biology:***

    It is also called ecology and it deals with the study of the interactions between the organisms and their environment.

11. ***Parasitology:***

    Parasitology deals with the study of parasites. Parasites are the organisms that take food and shelter from living hosts and, in return, harm their (hosts) lives.

12. ***Sociobiology:***

    In sociobiology we study the social behaviour of living organisms that make societies.

13. ***Biotechnology:***

    Biotechnology means the practical application of the living organisms to make substances for the welfare of mankind.

14. ***Immunology:***

    Immunology is the branch of biology which deals with the study of the immune

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السلام علیکم ورحمۃ اللہ وبرکاتہ:

معزز ممبران: آپ کا وٹس ایپ گروپ ایڈمن **"اردو بکس"** آپ سے مخاطب ہے۔

آپ تمام ممبران سے گزارش ہے کہ:

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- گروپ میں معزز، پڑھے لکھے، سلجھے ہوئے ممبرز موجود ہیں اخلاقیات کی پابندی کریں اور گروپ رولز کو فالو کریں بصورت دیگر معزز ممبرز کی بہتری کی خاطر ریموو کر دیا جائے گا۔
- کوئی بھی ممبر کسی بھی ممبر کو انباکس میں میسیج، مس کال، کال نہیں کرے گا۔ رپورٹ پر فوری ریموو کر کے کاروائی عمل میں لائے جائے گی۔
- ہمارے کسی بھی گروپ میں سیاسی و فرقہ واریت کی بحث کی قطعاً کوئی گنجائش نہیں ہے۔
- اگر کسی کو بھی گروپ کے متعلق کسی قسم کی شکایت یا تجویز کی صورت میں ایڈمن سے رابطہ کیجئے۔
- سب سے اہم بات:

گروپ میں کسی بھی قادیانی، مرزائی، احمدی، گستاخِ رسول، گستاخِ امہات المؤمنین، گستاخِ صحابہ و خلفائے راشدین حضرت ابو بکر صدیق، حضرت عمر فاروق، حضرت عثمان غنی، حضرت علی المرتضیٰ، حضرت حسنین کریمین رضوان اللہ تعالیٰ اجمعین، گستاخ اہلبیت یا ایسے غیر مسلم جو اسلام اور پاکستان کے خلاف پراپیگنڈا میں مصروف ہیں یا ان کے روحانی و ذہنی سپورٹرز کے لئے کوئی گنجائش نہیں ہے لہذا ایسے اشخاص بالکل بھی گروپ جوائن کرنے کی زحمت نہ کریں۔ معلوم ہونے پر فوراً ریموو کر دیا جائے گا۔

- تمام کتب انٹرنیٹ سے تلاش / ڈاؤنلوڈ کر کے **فری آف کاسٹ** وٹس ایپ گروپ میں شیئر کی جاتی ہیں۔ جو کتاب نہیں ملتی اس کے لئے معذرت کر لی جاتی ہے۔ جس میں محنت بھی صَرف ہوتی ہے لیکن ہمیں آپ سے صرف دعاؤں کی درخواست ہے۔
- عمران سیریز کے شوقین کیلئے علیحدہ سے عمران سیریز گروپ موجود ہے۔
- **لیڈیز کے لئے الگ گروپ کی سہولت موجود ہے جس کے لئے ویریفکیشن ضروری ہے۔**
- اردو کتب / عمران سیریز یا سٹڈی گروپ میں ایڈ ہونے کے لئے ایڈمن سے وٹس ایپ پر بذریعہ میسیج رابطہ کریں اور جواب کا انتظار فرمائیں۔ برائے مہربانی اخلاقیات کا خیال رکھتے ہوئے موبائل پر کال یا ایم ایس کرنے کی کوشش ہر گز نہ کریں۔ ورنہ گروپس سے تو ریموو کیا ہی جائے گا بلاک بھی کیا جائے گا۔

نوٹ: ہمارے کسی گروپ کی کوئی فیس نہیں ہے۔ سب فی سبیل اللہ ہے

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اللہ تبارک تعالیٰ ہم سب کا حامی و ناصر ہو

system of animals, which defends the body against invading (حملہ آور) microbes.

⑮ **Entomology:**

Study of insects is called entomology.

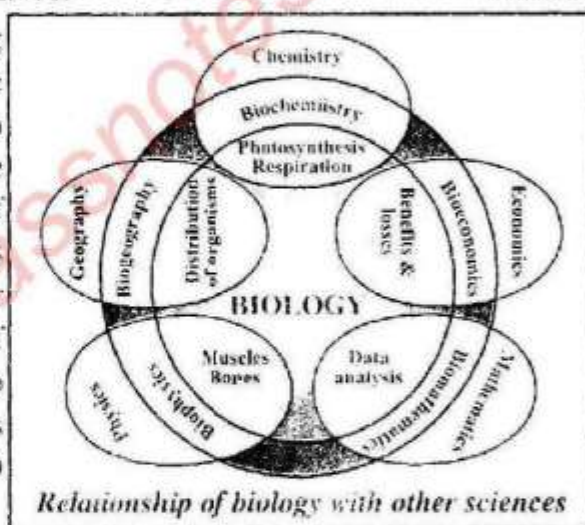
⑯ ***Pharmacology:***

Pharmacology is the study of drugs and their effects on the systems of human body.

1.1.2 RELATIONSHIP OF BIOLOGY TO OTHER SCIENCES

Q.3. Give points to advocate that biology is linked with physics, chemistry, mathematics, geography and economics.

Ans: Relationship of Biology to other Sciences:

The interrelationship (باہمی تعلق) among different branches of science cannot be denied. Biology includes information on various aspects of living things but these information relate to the other branches of science as well. Each branch of science has relationship with all other branches. For example, when studying the process of movement in animals, the biologists have to refer to the laws of motion in physics. This forms the basis of interdisciplinary (بین الکلیات علمی) sciences.

Relationship of biology with other sciences

① ***Biophysics:***

In biophysics, we study the principles of physics, which are applicable to biological phenomena. For example, the working principles of lever in physics and limbs (اعضا) of animals in biology are same.

② ***Biochemistry:***

Chemistry of different compounds and chemical processes of living organisms such as basic metabolisms of photosynthesis and respiration, are studied in biochemistry.

③ ***Biomathematics:***

Biomathematics deals with the study of biological processes using mathematical techniques and tools. To analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

④ **Biogeography:**

It studies the occurrence and distribution of different species of living organisms in different geographical regions of the world. It applies the knowledge of the characteristics of particular geographical regions to determine the characteristics of living

6 *Farming:*

In this profession different types of farms are developed and maintained. For example in some farms animal breeding technologies are used for the production of animals which are better protein and milk source. In poultry farms chicken and eggs are produced. Similarly in fruit farms, different fruit yielding plants are grown. A student who has gone through the professional course of agriculture (زراعت), animal husbandry or fisheries etc. can adopt this profession.

7 *Forestry:*

In forestry, professionals look after natural forests and advises to the government for planting and growing artificial (مصنوعی) forests. Many universities offer professional courses in forestry after the higher secondary education in biology or after bachelor level study of zoology and botany.

8 *Biotechnology:*

It is the latest profession in the field of biology. Biotechnologists study and work for the production of useful products through microorganisms. Universities offer courses in biotechnology after the higher secondary education in biology and after the bachelor level studies of botany or zoology.

1.1.3 QURAN AND BIOLOGY

Q.5. What do you know about the instructions and guidelines (ہدایات) given by the Holy Quran to unveil the unknown and hidden aspect of life?

Ans: Guidelines of Holy Quran to Reveal the Study of Life:

Origin of Life:

At many places in Holy Quran, Allah hints about the origin and characteristics of living organisms. In the same verses human beings have been instructed to expose (بےنقاب کرنا) the unknown aspects of life, after getting the hints, here are few examples of such guidelines.

وَجَعَلْنَا مِنَ الْمَآءِ كُلَّ شَیْءٍ حَیٍّ

"We made every living thing from water." (Sura: Ambia, Verse: 30)

We know that water makes the 60-70% of the composition of protoplasm of all living things. The above Verse hints at the common origin of all living things in water.

Origin of Man:

As Allah has ordered human beings to think at the hints (اشارے) given by Him, we should study living things so that the mysteries of their origin can be revealed.

خَلَقَ الْاِنْسَانَ مِنْ صَلْصَالٍ كَالْفَخَّارِ

"He made man from clay like the potter." (Sura: Rehman, Verse: 14)

Development of Animals:

Allah also hints at the method of the development (ترقی) of animals including human beings.

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظٰمًا فَكَسَوْنَا الْعِظٰمَ لَحْمًا ۝

"Then fashioned We the drop a clot (جماہواخون), then fashioned We the clot a little lump, then fashioned We the little lump bones, then clotted the bones with flesh"
(Sura: Al-Mominoon, Verse: 14)

وَاللّٰهُ خَلَقَ كُلَّ دَآبَّةٍ مِّنْ مَّآءٍ ۚ فَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى بَطْنِهٖ ۚ وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى رِجْلَيْنِ ۚ وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰٓى اَرْبَعٍ ؕ يَخْلُقُ اللّٰهُ مَا يَشَآءُ ؕ اِنَّ اللّٰهَ عَلٰى كُلِّ شَيْءٍ قَدِيْرٌ ۝

"Allah hath created every animal from water. Then some of them creep up over their bellies, others walk on two legs, and others on four. Allah creates what He pleases."
(Sura: Al-Nur, Verse: 45)

This Verse describes the common origin and modification (تبدیلی) of organisms. This Verse also supports the modern concepts of classification.

Quran hints not only at the origin and development of life but also at many characteristics of living organisms.

Q.6. Write down the contributions of Jabir Bin Hayyan, Abdul Malik Asmai and Bu Ali Sina in the field of biology.

Ans: Contributions of Jabir Bin Hayyan, Abdul Malik Asmai and Bu Ali Sina in the field of biology are discussed here.

① ***Jabir Bin Hayyan (721 - 815 AD):***

- He was born in Iran.
- He practised medicine in Iraq.
- He introduced experimental investigation (تجرباتی تحقیق) in chemistry.
- He wrote a number of books on plants and animals. His famous books are "Al-Nabatat (about plant life)" and "Al-Haywan (about animal life)"

② ***Abdul Malik Asmai (740 - 828 AD):***

- He is considered the first Muslim scientist who studied animals in detail.
- His famous books include "Al-Abil" (about camel), "Al-Khail (about horse)", "Al-Wahoosh (about wild (جنگلی) animal)", and "Khalq ul-insaan (about human being)".

③ ***Bu Ali Sina (980 - 1037 AD):***

- He is honoured as the founder (بانی) of medicine.
- He is known as Avicenna in the West.
- He was a great physician, philosopher, astronomer and poet.
- One of his books "Al-Qanun-fi al-Tib" is known as the canon (قانون) of medicine in West.

Bu Ali Sina and Jabir bin Hayyan

1.2 THE LEVELS OF ORGANIZATION

Q.7. Describe the levels of organization of life in detail.

Ans: THE LEVELS OF ORGANIZATOIN:

In order to understand the various phenomena of life, biologists study biological organization at different levels, Which are as follows.

① ***Subatomic and Atomic level:***

All types of matter (مادہ) are made up of elements and each element is made up of a single kind of atoms ('a': not, 'tom': cut). The atoms are actually formed by many subatomic particles. The most stable subatomic particles are electrons, protons and neutrons.

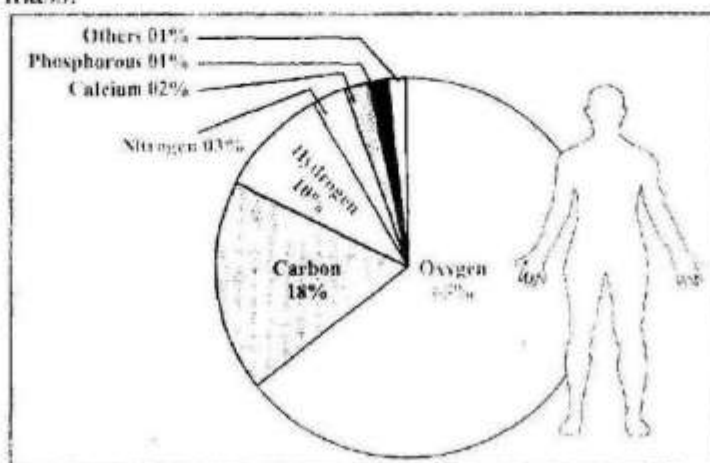
Naturally occurring elements:

There are about 92 kinds of elements those occur in nature.

Bioelements:

Out of the 92 kinds of elements that occur in nature, 16 are bioelemetns. These take part in making the body mass of a living organism. Out of these bioelements,

⇒ Only six (O, C, H, N, Ca, and P) make 99% of the total mass.

⇒ Other ten (K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn, and I) collectively (مجموعی) make 01% of the total mass.

Percentage composition (by mass) of bioelements in the protoplasm of living organisms

❷ ***Molecular level:***

In organisms, bioelements usually do not occur in isolated (اکیلے) forms rather they combine through ionic or covalent bonding. The stable particle formed by such bonding is called as molecule or biomolecule.

An organism is formed by enormous (بہت زیادہ) number of biomolecules of hundreds of different types. These molecules are the building material and are themselves constructed in great variety and complexity (پیچیدگی) due to specific bonding arrangements.

Biomolecules may be classified as:

- Micromolecules
- Macromolecules

Micromolecules are with low molecular weight e.g. glucose, water etc.

Macromolecules are with high molecular weights e.g. starch, proteins, lipids, etc.

❸ ***Organelle and Cell level:***

Biomolecules assemble in a particular way and form organelles.

The organelles are actually sub-cellular structures and when they assemble together, cells are formed. Cells are the unit (اکائی) of life.

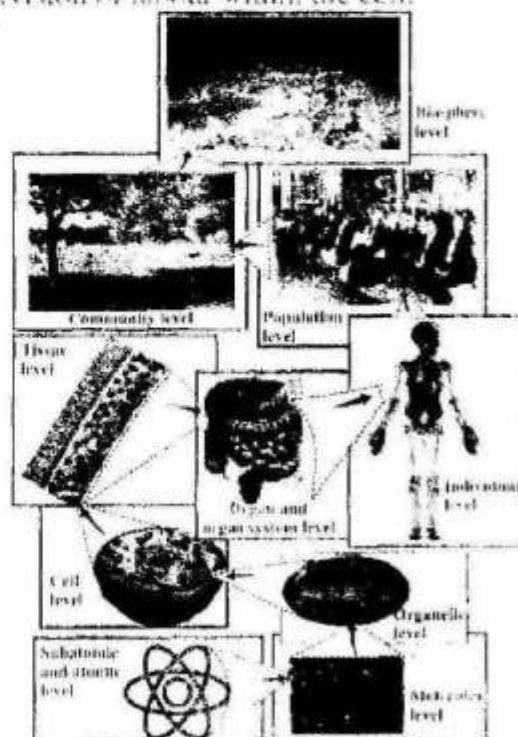
Specific function of organelle:

Each type of organelle is specialized to perform a specific function. For example: **mitochondria** are specialized for cellular respiration and **ribosomes** are specialized for protein synthesis. In this way, functions of the cell are accomplished (پایہ تکمیل) by these specialized structures. It is an example of the division of labour within the cell.

Multicellular and unicellular Organization:

In the case of prokaryotes and most protists, the entire organism consists of a single cell. In the case of most fungi, animals and plants, the organism consists of up to trillions (کھربوں) of cells.

❹ ***Tissue level:***

In multicellular organisms, similar cells (performing similar functions) are organized into groups, called tissues. We can define a tissue as a group of similar cells specialized for the performance (کارکردگی) of a common function. Each cell in a tissue carries on its own life processes (like cellular respiration, protein synthesis), but it also carries on some special processes related to the function of the tissue.

Levels of organization

Plant Tissues: There are different types of plant tissues e.g. epidermal tissue, ground tissue, etc.

Animal Tissues: Animal tissues are also of different types e.g. nervous tissue, muscular tissues etc.

⑤ *Organ and organ system level:*

Organ level:

In higher multicellular organisms, more than one type of tissue having related functions are organized together and make a unit, called organ. Different tissues of an organ perform their specific (خاص) functions and these functions collectively become the functions of that organ.

Example:

Stomach is an organ specialized for the digestion (ہاضمہ) of proteins and for storing food. Two major types of tissues are organized in its structure. **Epithelial (glandular) tissue** secretes (خارج کرتا ہے) the gastric juice for the digestion of proteins. **Muscular tissue** performs contractions (سکڑنا) of stomach walls for grinding of food, and moving food to posterior end. So, two tissues perform their specific functions, which collectively (اجتماعی طور پر) become the function of stomach.

Organ system level:

Different organs performing related functions are organized together in the form of an organ system. In an organ system, each organ carries out its specific function and the functions of all organs appear as the function of the organ system.

Example: Digestive system is an organ system that carries out the process of digestion. Major organs in its framework are oral cavity, stomach, small intestine (چھوٹی آنت), large intestine, liver (جگر), and pancreas (لبلبہ). All these organs help in the process of digestion.

The organ system level in plants:

The organ system level is less complex in plants (e.g. root system) as compared to animals.

⇒ This is due to a greater range of functions and activities in animals than in plants.

⑥ *Individual level:*

Different organs and organ systems are organized together from an individual or an organism. In organism, the functions, processes and activities of various organs and organ systems are coordinated (ملایا جاتا ہے).

Example:

When a man is engaged in continuous and hard exercise, not only his muscles are working but also there is an increase in the rate of respiration and heart beat. This accelerated rate (تیز ہوئی شرح) of respiration and heart beat supplies more oxygen and food to the muscles which they need for continuous work.

⑦ *Population level:*

Biologists extend their studies to the population level where they study interactions among member of the same species in the same habitat (مسکن).

Definition of population:

A population is defined as a group of organisms of the same species located at the same place, in the same time.

Example:

Human population in Pakistan in 2010 comprises of 173.5 million individuals (according to the Ministry of Population Welfare, Government of Pakistan).

⑧ *Community level:*

Definition of Community:

A community is an assemblage (مجموعہ) of different populations, interacting with one another within the same environment.

Example:

A forest may be considered as a community. It includes different plants, microorganisms, fungi, and animal species.

Communities are collections of organisms, in which one population may increase and others may decrease.

Complex communities:

Some communities are complex e.g. a forest community, a pond community etc.

Simple communities:

Some communities may be simple e.g. a fallen log with various populations under it. In a simple community number and size of populations is limited. So any change in biotic or abiotic factors may have drastic (شدید) and long lasting effects.

⑨ *Biosphere level:*

Definition of biosphere:

The part of Earth inhabited by organisms communities is known as biosphere.

It constitutes all ecosystems and is called the zone of life on Earth.

Definition of ecosystem:

Areas where living organisms interact with the nonliving components of the environment is called ecosystem.

1.2.1 CELLULAR ORGANIZATION

Q.8. What do you know about cellular organization amongst living organisms?

Ans: CELLULAR ORGANIZATION:

Major groups of organisms:

All the organisms have been divided into five major groups.

(1) Prokaryotes (2) Protists (3) Fungi (4) Plants (5) Animals

All organisms are made of cells.

Types of cells:

Cells are of two basic types.

i. Prokaryotic cells **ii.** Eukaryotic cells

Ways of organization of cells:

In living organisms the cells organize in three ways to make the bodies of organisms.

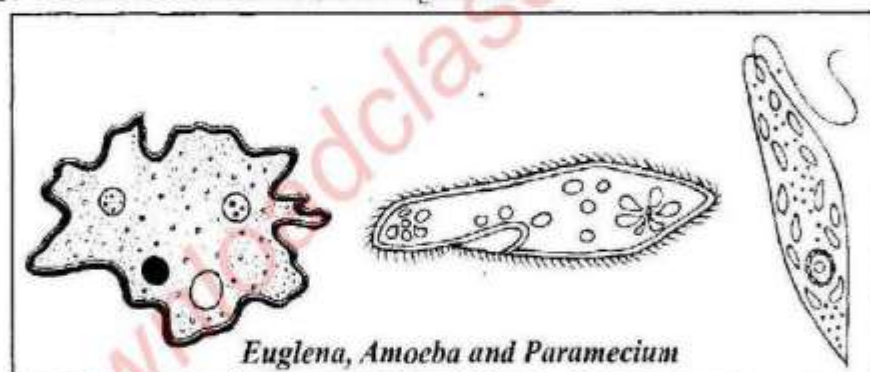
(i) Unicellular organization. (ii) Colonial organization

(iii) Multicellular organization

i. Unicellular Organization by unicellular organisms.

In unicellular organization, only one cell makes the life of an organism. All the life activities are carried out by the only cell.

Examples: Amoeba, Paramecium, and Euglena etc.

Euglena, Amoeba and Paramecium

ii. Colonial Organization by colonial organisms.

In colonial type of cellular organization, many unicellular organisms live together but do not have any division of labour among them. Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements.

Examples:

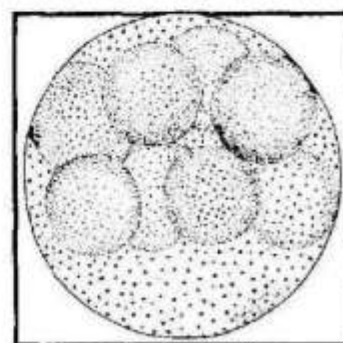
Volvox is a green alga found in water that shows colonial organization. Hundreds of Volvox cells make a colony.

Volvox colony

iii. Multicellular Organization by multicellular organisms.

In multicellular organization, cells are organized in the form of tissues, organs and organ systems.

Examples:

Frog and mustard are the familiar examples of multicellular organization.

① *Mustard plant.*

Mustard plant (scientific name: Brassica campestris) is sown (بویا جاتا ہے) in winter and it produces seeds at the end of winter.

Use of mustard plant:

The plant body is used as vegetable and its seeds are used for extracting (نکالنا) oil.

Types of organs:

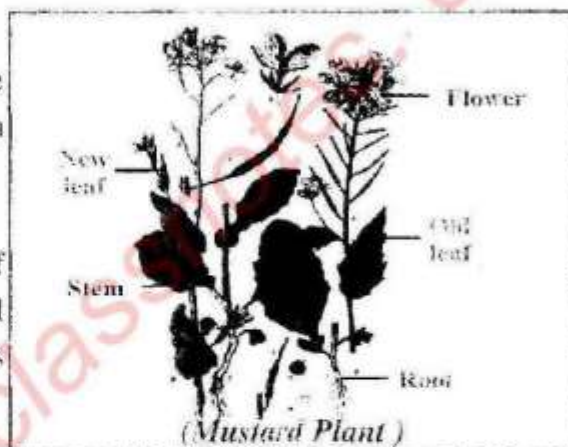
The organs of the body can be divided into two groups on the basis of their functions.

(i) ***Vegetative organs:***

Root, stem, branches and leaves are the vegetative organs, which do not take part in the sexual reproduction of the plant.

(ii) ***Reproductive organs:***

Flowers are the reproductive parts of the plant because they take part in sexual reproduction and produce (پیدا کرنا) fruits and seeds.

(Mustard Plant)

② ***Frog:***

Frog (scientific name: Rana tigrina) shows the multicellular organization. The body is made of organ systems and each organ system consists of related organs. All the organs are made of specific tissues (epithelial, glandular, muscular, nervous etc).

(Forg)

Q.9. How would you distinguish (فرق) the biomolecules from other molecules? What is the criterion (معیار) for classifying a biomolecules as micromolecule or macromolecule?

Ans: **Biomolecules** are present in living organisms and bioelements share their atoms in making biomolecules or molecules of life.

An organism is formed by enormous (بے شمار) number of biomolecules of hundreds of different types. These molecules are the building material and are themselves constructed in great variety and complexity due to specific bonding arrangements.

Biomolecules may be classified as:

- Micromolecules
- Macromolecules

Micromolecules are with low molecular weights e.g. glucose, amino acids, fatty acids etc.

Macromolecules are with high molecular weights e.g. starch, proteins, lipids, etc.

PRACTICAL WORK

Q.9. Describe the internal structure of a frog as an example of a multicellular animal through its dissection (چیر پھاڑ).

Ans: DISSECTION OF FROG:

Practical work:

Identification (پہچان) of organs and organ systems in dissected frog. The multicellular organization can be studied in a dissected frog. Different organs and organ systems can be identified and compared with the diagrams or figures given in books or charts.

Problem:

Identify the organs that make up the internal systems of the frog.

Purpose:

In laboratory, the teacher will dissect a frog in order to expose its external (بیرونی) and internal structures.

Background information:

Frog belongs to the class amphibia of the animal kingdom. It possesses multicellular organization consisting of tissues, organs and organ systems.

- On the outside of the frog's head are two external nostrils (نتھنے) ; two tympani (کان کے پردے), or eardrums; and two eyes, each of which has three lids. The third lid, called the nictitating membrane, is transparent (شفاف).
- The digestive system consists of the organs of the digestive tract and the digestive glands.
- The respiratory system (نظام تنفس) consists of the nostrils and the larynx, which opens into two lungs.
- The circulatory system (نظام دوران خون) consists of the heart, blood vessels, and blood.
- The urinary system (نظام اخراج) consists of the kidneys, ureters, bladder, and cloac
- The organs of the male reproductive system are testes, sperm ducts, and cloac The female system consists of ovaries, oviducts, uteri, and cloaca.
- The central nervous system (نظام اعصاب) of frog consists of the brain (دماغ), whicl enclosed in the skull, and the spinal cord, which is enclosed in the backb

(ریڑھ کی ہڈی). Nerves branch out from brain and spinal cord.

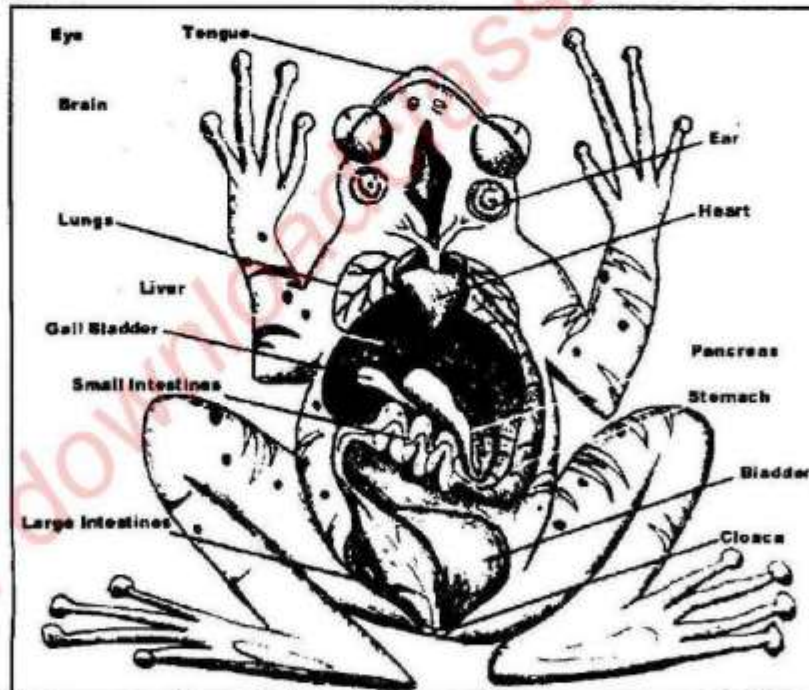
- The frog's skeletal and muscular systems consist of its framework of bones, to which all the skeletal muscles of the body are attached.

Material required:

Preserved (محفوظ کیا ہوا) frog, dissecting tray, paper towels and dissecting kit.

Procedure:

The teacher will place an unconscious (بےہوش) frog on a dissection tray on its back and pin down the legs. From the ventral side, teacher would lift the skin and use scissors to cut along the center of the body from the cloaca to the lip. Teacher would turn back the skin, cut towards the side at each leg, and pin the skin flat. Then he/she would lift and cut through the muscles and breast bone to open up the body cavity.

1. Use the diagram below to locate and identify the organs of the digestive system: esophagus, stomach, small intestine, large intestine, cloaca, liver, gallbladder, and pancreas.

2. Again refer to the diagram below to identify the parts of the circulatory and respiratory systems that are in the chest cavity. Find the left atrium, right atrium, and ventricle of the heart. Find the two lungs.

Use a probe and scissors to lift and remove the intestines and liver. Identify the parts of the urinary and reproductive systems. Find the ureters; the urinary bladder; the testes and sperm ducts in the male; and the ovaries, oviducts, and uteri in the female.

...move the kidneys and look for threadlike spinal nerves that extend from the spinal

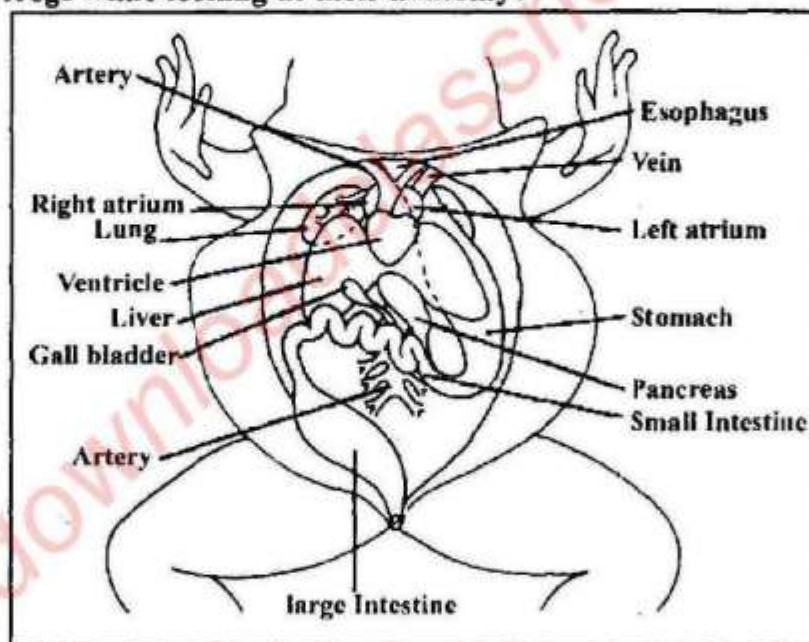
cord.

5. Dispose of your materials according to the directions from your teacher.
6. Clean up your work area and wash your hands before leaving the lab.

Observation:

After identifying the important organs and organ systems, draw your observation in the form of diagrams.

Evaluation:

i. **What may be the purpose of nictitating membrane in frog?**
ii. **On which side of body did you see the kidneys? Dorsal or ventral?**
iii. **Which part is the common passage in the digestive, excretory and reproductive systems?**
iv. **What was the sex of the dissected frog? How would you differentiate male and female frogs while looking at their anatomy?**

Anatomy of dissected frog

Review Questions

MULTIPLE CHOICE

1. **Members of the same species living in the same place at the same time make a;**
   (a) Habitat (b) Biosphere (c) Community (d) Population
2. **If a scientist is studying the methods of inserting human insulin gene in bacteria, which branch of biology may this be?**
   (a) Anatomy (b) Physiology (c) Biotechnology (d) Pharmacology

3. Which one will be the correct sequence of the levels of organization of life?
(a) Cell, organelle, molecule, organ, tissue, organ system, individual
(b) Molecule, tissue, organelle, cell, organ system, organ, individual
(c) Molecule, organelle, cell, tissue, organ, organ system, individual
(d) Organ system, organ, tissue, cell, molecule, organelle, individual

4. Which of these major bioelements is in the highest percentage in protoplasm?
(a) Carbon (b) Hydrogen (c) Oxygen (d) Nitrogen

5. Which of the following groups includes organisms all of which are absorptive in their nutrition?
(a) Protists (b) Animals (c) Bacteria (d) Fungi

6. Similar cells organized into groups and performing same functions, are known as:
(a) Organelle (b) Tissue (c) Organ (d) Organ system

7. Which of these tissues also makes the glandular tissue in animals?
(a) Epithelial tissue (b) Muscular tissue
(c) Connective tissue (d) Nervous tissue

8. The level of organization that is less definite in plants is:
(a) Tissue level (b) Organ level
(c) Organ system level (d) Individual level

9. What is TRUE about Volvox?
(a) Unicellular prokaryote (b) Unicellular eukaryote
(c) Colonial eukaryote (d) Multicellular eukaryote

10. When we study the feeding relations among different animal species of a forest, at what level of organization we are studying?
(a) Individual (b) Population (c) Community (d) Biosphere

Ans: **1.** Population **2.** Biotechnology
3. Molecule, organelle, cell, tissue, organ, organ system, individual **4.** Oxygen
5. Fungi **6.** Tissue **7.** Epithelial tissue **8.** Organ system level
9. Colonial eukaryote **10.** Community

UNDERSTANDING THE CONCEPTS

1. Arrange these structures in order of lower level of organization to upper level and write the level against the each structure.
Neuron, nervous system, electron, man, mass of neurons, carbon, mitochondria, brain, protein

Answer:

1.	Electron	Subatomic level
2.	Carbon	Atomic level
3.	Protein	Biomolecule level
4.	Mitochondria	Organelle level
5.	Neuron	Cellular level
6.	Mass of neuron	Tissue level
7.	Brain	Organ level
8.	Nervous system	Organ system level
9.	Man	Individual level

2. How would you define biology and relate it with its major divisions?

Ans: See Q. No.1.

3. Draw a table showing the branches of biology and the studies these deal with.

Ans: See Q. No.2.

4. Give points to advocate that biology is linked with physics, chemistry, mathematics, geography and economics.

Ans: Refer to Q.No.3 for your answer.

5. How would you distinguish the biomolecules from other molecules? What is the criterion for classifying a biomolecule as micromolecule or macromolecule?

Ans: Refer to Q.No.9 for your answer.

6. Describe the levels of organization of life.

Ans: Refer to Q.No.7 for your answer.

7. Is there any division of labour among the cells of a colony? If you find division of labour among the cells and tissue what level of cellular organization is it?

Ans: Refer to Q.No.8 for your answer.

SHORT QUESTIONS

1. Define biotechnology.

Ans. Biotechnology is the branch of biology which deals with the practical application of living organisms to make substances for the welfare of mankind.

2. What do you mean by horticulture and how is it related to agriculture?

Ans. Horticulture deals with the art of gardening. A horticulturist works for the betterment of existing varieties and for the production of new varieties of

ornamental plants and fruit plants. This profession deals with agriculture because agriculture deals with the food crops which are the source of food.

THE TERMS TO KNOW

Agriculture:

This profession deals with the food crops and animals which are the source of food.

Anatomy:

Anatomy is the branch of biology which deals with the internal structure of living organisms.

Animal husbandry:

It is the branch of agriculture concerned with the care and breading of domestic animals (Livestock) e.g. cattle, sheep.

Biochemistry:

Biochemistry is the branch of biology which deals with the study of the chemistry of different compounds and processes occurring in living organisms.

Bioeconomics:

Bioecnomics is the branch of biology which deals with the study of organisms from economical point of view.

Bioelement:

The elements which take part in making the body mass of living organism are called biolements.

Biogeography:

Biogeography is the branch of biology which deals with study of occurrence and distribution of different species of living organisms in different geographical region of the world.

Biology:

Biology is the branch of science which deals with the study of living organisms.

Biomathematics:

It is the branch of biology which deals with the study of biological processes using mathematical techniques and tools.

Biomolecule:

In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bond. The stable particle formed by such bonding is called biomolecule.

Biophysics:

It deals with the study of the principles of physics, which are applicable to biological phenomena.

Biotechnology:

Biotecnology is the technique in which micro-organisms are used for the welfare of mankind.

Botany:

Botany is the branch of biology which deals with the study of plants.

Cell:

Cell is the basic functional and structural unit of life.

Cell biology:

Cell biology is the branch of biology which deals with the study of cell.

Colony:

Many unicellular organisms live together to form a colony. In a colony each unicellular organism does not depend on other cells for its vital requirements.

Community:

A community is an assemblage of different populations, interacting with one another with in the same environment.

Embryology:

Embryology is the study of the development of an embryo to new individual.

Entomology:

Entomology is the study of insects.

Environmental biology:

It deals with the study of the interactions between the organism and their environment.

Farming:

Farming deals with the development and maintenance of different types of farms.

Fisheries:

Fisheries is the professional study of fish production.

Forestry:

In forestry, professionals look after natural forests and advises to the government for planting and growing artificial forests.

Fossil:

Fossils are the remains of extinct organisms.

Genetics:

The study of genes and their roles in inheritance is called genetics.

Histology:

Histology is the microscopic study of tissues.

Horticulture:

Horticulture deals with the art of gardening.

Immunology:

Immunology deals with the study of the immune system of animals, which defends the body against invading microbes.

Inheritance:

Inheritance means the transmission of characters from one generation to the other.

Macromolecule:

The molecules with high molecular weights are called macromolecules. e.g. starch, protein.

Microbiology:

The branch of biology which deals with the study of micro organisms is called microbiology.

Micromolecule:

The molecules with low molecular weights are called micromolecule. e.g. water, glucose etc.

Microorganism:

The organism which can not be seen with naked eye and can be seen only with microscope are called microorganism.

Morphology:

The branch of biology which deals with the study of structures of living organisms.

Organ:

More than one type of tissue having related functions are organized together to make organ.

Organ system:

Different organs performing related functions are organized together in the form of an organ system.

Organelle:

Biomolecules assemble in a particular way and form organelles.

Palaeontology:

Palaeontology is the study of fossils.

Parasite:

Parasite is the organism that takes food and shelter from living hosts and, in return, harm them.

Parasitology:

Parasitology is the branch of biology which deals with the study of parasites.

Pharmacology:

Pharmacology is the study of drugs and their effects on the systems of human body.

Physiology:

Physiology is the branch of biology which deals with the study of functions of different parts of living organisms.

Population:

A population is defined as a group of organisms of the same species located at the same place, in the same time.

Prokaryote:

The organisms in which nuclear envelope is absent in their cells are called prokaryote.

Protist:

Protist is a eukaryotic unicellular and simple multicelluar organism.

Science:

Science is the study in which observations are made, experiments are done and logical conclusions are drawn in order to understand the principles of nature.

Socio-biology:

Socio-biology is the branch of biology which deals with the study of social behaviour of the animals that make societies.

Surgery:

Surgery is the profession of medicine. In surgery the parts of body may be repaired, replaced or removed.

Taxonomy:

Taxonomy deals with the study of the naming and classification of organisms into groups and subgroups.

Tissue:

Similar cells (performing similar functions) are organized into groups, called tissue.

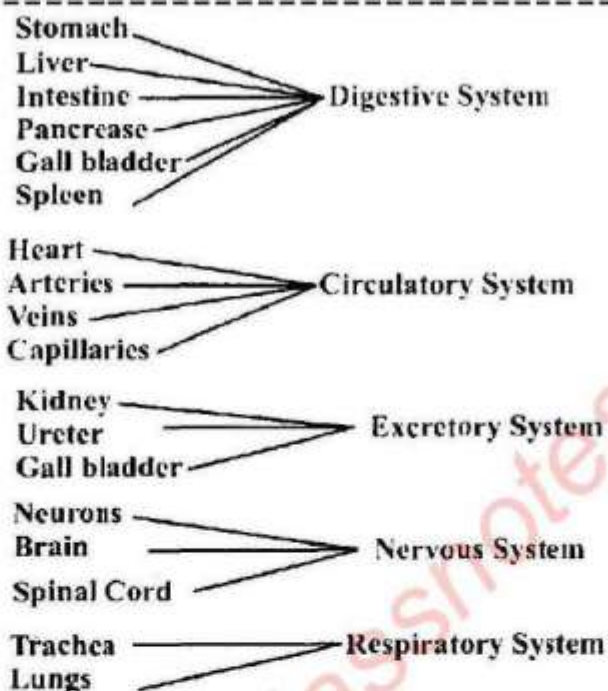
Volvox:

Volvox is a unicellular organism, which lives in the form of colony.

Zoology:

Zoology is the branch of biology which deals with the study of animals.

INITIATING AND PLANNING

1. ***Draw a linkage chart connecting different organs with the relative organ systems.***

ANALYZING AND INTERPRETING

1. Identify different tissues in the photomicrographs of different organs.

ACTIVITIES

1. Identify major organs and organ systems in a dissected frog (Dissection by teacher/ demonstrators).

SCIENCE, TECHNOLOGY AND SOCIETY

1. Identify and evaluate the impact of scientific ideas and/or advancements in technology on society.
2. List organs of human body that some notorious diseases of today damage and specify the ones, which can be transplanted.

ON-LINE LEARNING

- www.biology-online.org/dictionary/Branches_of_biology
- en.allexperts.com/q/Biology-664/
- www.usoe.k12.ut.us/curr/Science/sciber00/7th/cells/sciber/ levelorg.htm
- www.ofsd.k12.wi.us/science/frogdiss.htm

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ Tick the correct answer.

1. **The famous book 'Al-Abil' is:** (LHR. GI)
   (A) Jabir bin Hayan (B) Abdul Malik Asmai (C) Bu Ali Sina (D) Darwin
2. **Amoeba is:** (LHR. GI)
   (A) Autotrophs (B) Heterotrophs (C) Both A & B (D) Ectoparasite
3. **The study of fossils is called:** (LHR. GII, BWP. GII, GRW. GII, SGD. GI)
   (A) Immunology (B) Pharmacology (C) Palaeontology (D) Parasitology
4. **Jabir Bin Hayan was born in:** (LHR. GII, FBD. GI, MLN. GII, RWP. GI)
   (A) Iraq (B) Iran (C) Pakistan (D) England
5. **The Surah of Quran which verifies classification is:** (GRW. GI)
   (A) Baqra (B) Al-Noor (C) Quresh (D) Yasin
6. **Brassica compestiris is the scientific name of the plant _____.** (GRW. GI, DGK. GII)
   (A) mustard (B) mango (C) tomato (D) potato
7. **The study of internal structure is called:** (GRW. GII, MLN. GII, SWL. GII, RWP. GI)
   (A) Marphology (B) Physiology (C) Anatomy (D) Cell Biology
8. **Same species living in the same place at the same time make a _________.** (GRW. GII, SWL. GI, LHR. GII)
   (A) habitat (B) biosphere (C) community (D) population
9. **The word biology has been derived from two words:** (FBD. GI, RWP. GII)
   (A) English (B) Greek (C) Latin (D) French
10. **In 2010 the population of human in Pakistan was: (million)** (FBD. GII)
    (A) 117.5 (B) 173.5 (C) 176.5 (D) 198.5
11. **The maximum percentage of bioelements found in protoplasm is:** (FBD. GII)
    (A) Carbon (B) Hydrogen (C) Nitrogen (D) Oxygen
12. **The microscopic study of tissues is called:** (MLN. GI, DGK. GI, LHR. GI, BWP. GI, & GII)
    (A) Morphology (B) Histology (C) Physiology (D) Cell Biology
13. **What is true about volvox?** (SWL. GI)
    (A) unicellular eukaryote (B) multicellular eukaryote
    (C) unicellular prokaryote(D) colonial eukaryote
14. **Gardening belongs to the profession:** (SWL. GII)
    (A) Farming (B) Forestry (C) Agriculture (D) Horticulture

15. **The study of Genes and their roles in inheritance is called:** (SGD. GI)
    (A) Histology (B) Anatomy (C) Genetics (D) Physiology
16. **The total number of elements in nature are:** (SGD. GI)
    (A) 92 (B) 93 (C) 91 (D) 90
17. **Honoured as the founder of Medicine:** (SGD. GII)
    (A) Jabir Bin Hayan (B) Bu-Ali-Sina
    (C) Umer Khiyam (D) Abdul Malik Asmai
18. **The author of Al-Qanoon fil-Tib is:** (RWP. GI, GRW. GII, BWP. GII)
    (A) Jabir bin Hayyan (B) Ali-Ibne-Eisa
    (C) Abdul Malik Asma (D) Bu-Ali-Sena
19. **The scientific study of plants is called:** (RWP. GII)
    (A) Botany (B) Zoology (C) Anatomy (D) Histology
20. **The part of Earth where communities of living organisms exist is called:** (RWP. GII)
    (A) Atmosphere (B) Oosphere (C) Biosphere (D) Population
21. **The number of bioelements in nature is:** (DGK. GI)
    (A) 15 (B) 16 (C) 17 (D) 18
22. **The example of Colonial Organization is:** (BWP. GI)
    (A) Volvox (B) Spyrogyra (C) Euglena (D) Bacteria
23. **The branch of Biology dealing with insects is:** (BWP. GI, GRW. GI, MLN. GII, SWL. GII)
    (A) Entomology (B) Cell Biology (C) Botany (D)zoology
24. **The reproductive organ of plant is:** (LHR. GI, GRW. GI)
    (A) Root (B) Stem (C) Leaf (D) Flower
25. **An example of organ is:** (FBD. GI)
    (A) Neuron (B) Electron (C) Carbon (D) Stomach
26. **An example of biomolecule is:** (FBD. GI)
    (A) Proton (B) Protein (C) Iodine (D) Chlorine
27. **Similar cells organized into groups and performing same functions are known as:** (FBD. GII)
    (A) Organelles (B) Tissues (C) Organ (D) Organ system
28. **The study of the functions of different parts of living organisms is called:** (MLN. GII)
    (A) Morphology (B) Anatomy (C) Histology (D) Physiology
29. **Unicellular is:** (SWL. GI)
    (A) Rabbit (B) Euglena (C) Horse (D) Frog
30. **Which one of the following is Macromolecule?** (SWL. GI)
    (A) Glucose (B) Water (C) Hydrogen (D) Starch
31. **The book "Al-Nabatat" belongs to the Muslim scientist.** (SWL. GII)
    (A) Jabir bin Hayan (B) Abdul Malik Asmmi
    (C) Bu-Ali-Sina (D) Ibn-Al-Nafees

32. Example of macromolecule is: (SGD. GI)
(A) Lipid (B) Water (C) Glucose (D) Carbondioxide

33. It deals with the compounds of living organisms: (SGD. GII)
(A) Biophysics (B) Biochemistry (C) Bioeconomics (D) Biometry

34. Which level of organization is not visible in plants? (RWP. GII)
(A) Organism (B) Organ system level (C) Organ (D) Tissue

35. The scientific study of living things is called: (DGK. GI)
(A) Physics (B) Chemistry (C) Biology (D) Farming

36. In how many groups biomolecules are divided? (DGK. GII)
(A) Two (B) Three (C) Four (D) Five

37. Mustard plant is Sown in: (BWP. GI)
(A) In Winter (B) In Summer (C) In Spring (D) In Autumn

Answers

1. Abdul Malik Asmai 2. Heterotrophs 3. Palaeontology 4. Iran
5. Al-Noor 6. mustard 7. Anatomy 8. population 9. Greek
10. 173.5 11. Oxygen 12. Histology 13. colonial eukaryote
14. Horticulture 15. Genetics 16. 92 17. Bu-Ali-Sina
18. Bu-Ali-Sena 19. Botany 20. Biosphere 21. 16
22. Volvox 23. Entomology 24. Flower 25. Stomach
26. Protein 27. Tissues 28. Morphology 29. Euglena 30. Starch
31. Jabir bin Hayan 32. Lipid 33. Biochemistry 34. Organism
35. Biology 36. Two 37. In Winter

☆ Give short answers to the following questions.

1. Explain macromolecules with an example. (LHR. GI)

Ans: Macromolecules: Molecules with high molecular weight are called macromolecules. e.g. Starch, Protein etc.

2. What do you mean by Organ System? (LHR. GI, & GII)

Ans: Different organs performing related functions are organized together in the form of an organ system. In an organ system, each organ carries out its specific function and the functions of all organs appear as the function of organ system.

3. Define Biotechnology. (LHR. GII. FBD. GII. SWL. GII)

Ans: Biotechnology is the branch of biology which deals with the practical application of living organisms to make substances for the welfare of mankind.

4. Describe two scientific contributions of Bu Ali Sina. (LHR. GII. FBD. GI. SGD. GI)

Ans: Bu Ali Sina (980 - 1037 AD) is honoured as the founder of medicine and called as Avicenna in the West. He was a physician, philosopher, astronomer and poet. One of his books "AL-Qanun-fi al-Tib" is known as the canon of medicine in West.

5. How cell biology is different from histology? (GRW. GI, SWL. GI, RWP. GI)

Ans: Cell biology is the branch of biology which deals with study of cell, while microscopic study of tissues is called histology.

6. Name any four unicellular organisms. (GRW. GI, MLN. GII, FBD. GI)

Ans: Bacteria, amoeba, paramecium and euglena are four examples of unicellular organisms.

7. What is meant by colonial organization? (GRW. GII)

Ans: In colonial type of cellular organization, many unicellular organisms live together but do not have any division of labour among them. Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements.

Examples: Volvox is a green alga that shows colonial organization. Hundreds of Volvox cells make a colony.

8. Write the names of vegetative organs of plant. (GRW. GII)

Ans: Root, stem and leaves are vegetative organs of plants.

9. Write the names of three main divisions of biology. (FBD. GI)

Ans: Biology have been divided into three main divisions:

☆ Zoology ☆ Botany ☆ Microbiology

10. What are parasites? Give an example. (FBD. GI, LHR. GI, RWP. GII)

Ans: The organism that take food and shelter from living hosts and in return harm them are called parasites. e.g mosquito.

11. What is habitat and how it is different from community? (FBD. GII)

Ans: The area of environment in which organism live is called habitates.

Habitat is different from community because in a community different organism lives in different types of habitates.

12. What is meant by Biogeography? (MLN. GII, GRW. GII)

Ans: It studies the occurrence and distribution of different species of living organisms in different geographical regions of the world. It applies the knowledge of the characteristics of particular geographical regions to determine the characteristics of living organisms found there.

13. What is meant by Bioelements? (MLN. GII, DGK. GII, GRW. GI)

Ans: Those elements which are the constituents (parts) of livings are called bioelements.

14. Define Histology. (SWL. GI)

Ans: Histology is the microscopic study of tissues and their functions.

15. Define entomology. (SWL. GII)

Ans: The branch of biology which study insects is called entomology.

16. Write the scientific name of mustard plant. (SWL. GII, SGD. GI, DGK. GII)

Ans: The scientific name of mustard plants is Brassica campestris.

17. Define Molecular Biology. (SGD. GI, RWP. GII)

Ans: Molecular biology (biochemistry) deals with the study of the molecules of life; e.g. water, proteins, carbohydrates, lipids, and nucleic acids.

18. Briefly explain tissue level. (FBD. GI, SGD. GI, RWP. GI)

Ans: In multicellular organisms, similar cells (performing similar functions) are organized into groups, called tissues. Tissues are a group of similar cells specialized for the performance of a common function. Each cell in a tissue carries on its own life processes (like cellular respiration, protein synthesis), but it also carries on some special processes related to the function of the tissue.

19. Give the two examples of Macromolecules. (SGD. GII)

Ans: Examples of macromolecules are starch and proteins.

20. What is meant by fossils? (SGD. GII)

Ans: The remainder of old plants and animals are called fossil fuels.

21. What is immunology? (RWP. GII)

Ans: Immunology is the branch of biology which deals with the study of the immune system of animals, which defends the body against invading microbes.

22. What is biosphere level? (RWP. GII, DGK. GI, BWP. GII, SWL. GII)

Ans: The part of Earth inhabited by organisms communities is known as biosphere. It constitutes all ecosystems and is called the zone of life on Earth.

23. What do you know about Genetics? (DGK. GI)

Ans: Genetics is the study of genes and their roles in inheritance. Inheritance means the transmission of characters from one generation to the other.

24. What is difference between population and community? (DGK. GI)

Ans: Population: A population is a group of organisms of the same species located in the same place, at the same time. For example, number. Human population in Pakistan in 2010 is 173.5 million.

Community: A community is an assemblage of different populations, interacting with one another within the same environment. A forest may be considered as a community.

25. Differentiate between Zoology and Botany. (DGK. GI)

Ans: Zoology: Zoology is the major division of biology which deals with the study of animals.

Botany: Botany is a division of biology which deals with the study of plants.

26. Differentiate between Physiology and Taxonomy. (DGK. GII)

Ans: Physiology: Physiology deals with the study of the functions of different parts of living organisms.

Taxonomy: Taxonomy is the study of the naming and classification of organisms into groups and subgroups.

27. Name famous books of Jabir Bin Hayan and Abdul Malik Asmai. (FBD. GII, SGD. GII, BWP. GI)

Ans: Famous books of Jabir Bin Hayan: His famous books are "Al-Nabatat (about plant life)" and "Al-Haywan (about animal life)"

Famous books of Abdul Malik Asmai: His famous books include "Al-Abil" (about camel), "Al-Khail (about horse)", "al-Wahoosh (animal)", and "Khalq al-insaan (about human being)".

28. What do you mean by Horitculture? How it is related to Agriculture? (SWL. GII, BWP. GI)

Ans: This profession includes the art of gardening. A Horticulturist works for the betterment of existing varities and for the production of new varities of ornamental plants and fruit plants. Gardening, ornamental plants and fruit plants are related to agriculture, So, horticulture is related to agriculture.

29. Define Biophysics and Biochemistry. (LHR. GI, BWP. GI, SGD. GII, BWP. GII)

Ans: 1. Biophysics: In biophysics, we study the principles of physics, which are applicable to biological phenomena. For example, the working principles of lever in physics and limbs of animals in biology are same.

2. Biochemistry: Chemistry of different compounds and chemical processes of living organisms such as basic metabolisms of photosynthesis and respiration, are studied in biochemistry.

30. Why Jabar bin Hayan is famous for? (BWP. GII)

Ans: Jabir Bin Hayan famous for:

- He introduced experimental investigations in chemistry.
- He wrote a number of books on plants and animals. His famous books are "Al-Nabatat (about plant life)" and "Al-Haywan (about animal life)"

31. How biotechnology helps mankind? Explain. (LHR. GII)

Ans: The latest profession in the field of biology is biotechnology. It help in preparation of large amount of food for human being, latest medicines have been evolved by using biotechnology, which are now more effective.

32. Differentiate between Physiology and Morphology. (GRW. GI)

Ans: This branch deals with the study of the functions of different parts of living organism, while study of form and structure of living organisms is known as morphology.

33. What is meant by bioelements? What is their number? (GRW. GI)

Ans: Those elements which take part in making the body mass of living organism are called bioelements. Out of total elements 16 are known as bioelements.

34. Define biometry. (FBD. GII)

Ans: Biometry deals with the study of biological process using mathematical techniques and tools. To analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

35. What is farming? (FBD. GII)

Ans: In this profession different types of farms are developed and maintained. For

example in some farms animal breeding technologies are used for the production of animals which are better protein and milk source. In poultry farms chicken and eggs are produced. Similarly in fruit farms, different fruit yielding plants are grown.

36. What are the achievements of Jabir Bin Hayan? (MLN. GI)

Ans:
- He introduced experimental investigation in chemistry.
- He wrote a number of books on plants and animals. His famous books are "Al-Nabatat (about plant life)" and "Al-Haywan (about animal life)"

37. What is meant by unicellular organisms? (SWL. GI, MLN. GII)

Ans: Those organism which consist on single cell are called unicellular organism e.g. Amoeba, bacteria.

38. Write the importance of Mustard Plant. (MLN. GII)

Ans:
☆ Mustard plant is used as vegetables.
☆ Seeds of mustard plant is used to extract oil.

39. Write the names of six important bioelements. (SWL. GI)

Ans: Following are six important bioelements:
O,C,H,N,Ca and P.

40. Describe Animal Husbandary as career in biology. (SGD. GI)

Ans: The branch of biology concerned with the care and breeding of domestic animals like cattle and sheep etc. professional cources in animal husbandry can be adopted after the higher secondary education in biology.

41. What are micromolecules and macromolecules? (SGD. GII)

Ans: Micromolecules: The low molecular weight molecules are called micromolecules e.g glucose, water.

Macromolecule: The higher molecular weight molecules are called macromolecules. e.g starch, proteins, lipids.

42. Describe any two applications of Horticulture in daily life. (RWP. GII)

Ans: Horticulture deals with the betterment of existing varieties of plants.
It also study about the more yield production of fruit and crops plants.

43. Name vegetative and reproductive parts of Mustard plant. (RWP. GII)

Ans: Root, stem, branches and leaves are vegetative organs of mustard plant while flowers are the reproductive parts of mustard plant.

44. Give the scientific names of Mustard plant and Frog. (BWP. GI)

Ans: The scientific name of mustard plant is Brassica compestris and of frog is Rana tigrina.

45. Write about Jaber Bin Hayan and his two famous books. (MLN. GI, DGK. GI)

Ans: He was born in Iran and practised medicine in Iraq. Jabir bin Hayan wrote a number of books on plants and animals, his famous books are Al-Nabatat and Al-Hayan.

SOLVING A BIOLOGICAL PROBLEM

Major Concepts:

- **2.1 Biological Method**
  - 2.1.1-Scientific (biological problem), hypothesis, deductions and experiments
  - 2.1.2-Theory, law and principles
- **2.2 Data organization and data analysis**
- **2.3 Mathematics as an integral part of the scientific process**

Q.1. Why scientific methods are used by biologists?

Ans: SCIENTIFIC METHOD: (سائنسی طریقہ کار)

As the science is an organized (منظم) knowledge obtained from different observations (مشاہدات) and experiments (تجربات) carried out to determine (دریافت کرنا) the principles (اصول) about how the nature works. Chemists, biologists, ecologists and physicist, all use the same scientific method to make and test new theories.

2.1 BIOLOGICAL METHOD

Q.2. What do you mean by biological method of study? What is its significance (اہمیت)?

Ans: Man has always been a biologist. He had to be a biologist in order to live. Early in history (تاریخ), he was a hunter of animals and a gatherer (جمع کرنے والا) of fruits, seeds, roots etc. The more he knew about animals and their habitat (مسکن), the more successful (کامیاب) hunter he was. The more he knew about plants, the better he distinguished (فرق کیا) between edible (کھانے کے قابل) from non-edible plants.

Biological Method of Study:

Investigations (تحقیقات) about living things have provided problems that man has solved to aid (مدد) his own survival (بقا) and to satisfy (مطمئن) his desire to know.

The scientific method, in which biological problems are solved, is termed as biological method of study.

Significance:

The biological method has played an important part in scientific research for almost

500 years.

- From Galileo's experiment back in the 1590s to current research (موجودہ تحقیق), the biological method has contributed (کردار ادا کیا) to the advancements (ترقی) in medicine, ecology, technology.
- The biological method also ensures (یقینی کر لیا) the quality of data for public use.

2.1.1 BIOLOGICAL PROBLEM, HYPOTHESIS, DEDUCTIONS AND EXPERIMENTS

Q.3. Write a comprehensive note on biological method of study to solve a problem in biology.

Ans: In biology, new things are being discovered and long-held theories are being modified (ترمیم کیا جانا) or replaced with better ones as more data/knowledge is accumulated (اکٹھا کیا جاتا ہے۔). This happens when biologists recognize (شناخت) some biological problem and go for its solution.

To solve a problem in biology, a biologist takes following steps (مراحل):

1. Recognition of biological problem
2. Observations
3. Hypothesis formulation
4. Deductions
5. Experimentation
6. Summarization of results (create tables, graphics etc.)
7. Reporting the results

These steps are explained below:

1. Recognition (پہچان) of biological problem:

A biologist adopts (انتخاب چننا) biological method of study when he/she encounters (سامنا کرنا) some biological problem. A biological problem is a question related (متعلق) to living organisms that is either asked by some one or comes in the biologist's mind by himself.

2. Observations: (مشاہدات)

To solve a biological problem, the biologist recalls the previous (سابقہ) observations or makes new ones. Observations are made with five senses of vision, hearing, smell, taste and touch.

Types of observations:

Observations may be:

1. Quantitative Observations
2. Qualitative Observations

1. Quantitative Observations:

Quantitative observations are considered (سمجھی جاتی ہیں) more accurate (درست) because these are invariable (غیر متغیر) and measurable (قابل پیمائش) and can be recorded in terms of numbers.

Example: The freezing point (نقطہ انجماد) of water is 0°C and the boiling point (نقطہ جوش) is 100°C.

2. *Qualitative Observations:*

Qualitative observations (کیفیتی مشاہدے) are lesser accurate because these observations are variable (متغیر) and are not measurable. These observations can be recorded in terms of condition.

Example: The freezing point (نقطہ انجماد) of water is colder than the boiling point.

Observations also include reading and studying what others have done in the past because scientific knowledge is ever-growing (ہر دم بڑھ رہی ہے).

3. *Hypothesis Formulation (مفروضے کی بناوٹ):*

Observations do not become scientific observations until they are organized and related to a question.

Biologist organizes observations into data form and constructs a statement that may prove to be the answer of the biological problem under study. This tentative (عارضی) explanation of the observations is called a hypothesis. It may be defined as a proposition that might be true.

Characteristics (خاصیتیں) of good hypothesis:

A good hypothesis should have the following characteristics.

(a) It should be a general statement.
(b) It should be a tentative idea.
(c) It should agree with available observations.
(d) It should be kept as simple as possible.
(e) It should be testable and potentially falsifiable (قابل تکذیب). In other words, there should be a way to show the hypothesis is false; a way to disprove the hypothesis.

Biologists use **reasoning** to formulate a hypothesis.

Careful and creative thinking:

A great deal of careful and creative (تخلیقی) thinking is necessary for the formulation of a hypothesis.

4. *Deductions:*

Biologist draws deductions from the hypotheses. Deductions are the logical consequences (نتائج) of the hypotheses. For this purpose, a hypotheses is taken as true and expected results are drawn from it.

Generally in biological method, if a particular hypothesis is true then one should expect (deduction) a certain result. This involves the use of "if-then" logic (منطق).

5. *Experimentation:*

Most basic step of biological method is experimentation (آزمائش). Biologist performs experiments to see if the hypotheses are true or not. The deductions, which are drawn from hypotheses, are subjected to rigorous (شدید) testing. Through this stage, biologist learns which hypothesis is actually true. The incorrect hypotheses are rejected and the

one which proves correct is accepted.

Importance of accepted hypotheses:

An accepted hypothesis makes further predictions (پیشین گوئی) that provide an important way to further test its validity (معقولیت).

6. *Summarization (تلخیص) of results:*

The biologist gathers actual, quantitative data from experiments. Data for each of the groups are then averaged and compared statistically. To draw conclusions, the biologist also uses statistical analysis (تجزیہ).

7. *Reporting the results:*

Biologists publish their findings in scientific journals and books, in talks at national and international (بین الاقوامی) meetings and in seminars at colleges and universities.

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

Q.4. Describe the steps involved in biological method taking malaria as an example.

Ans: MALARIA:

Malaria is a common disease (بیماری) in many countries including Pakistan. Malaria has killed more people than any other disease.

History:

In ancient times (پرانے وقتوں میں) (more than 2000 years ago), physicians were familiar (واقف تھے) with the disease. They described it as a disease of chills (کپکپی) and fevers with recurring attacks. They also observed that the disease was more common among people living in low, marshy (دلدلی) areas.

It was thought that the stagnant (ٹھہرا ہوا) water of marshes poisoned the air and as a result of breathing in this "bad air", people got malaria.

This belief led to the name of this disease. The Italian words **"mala"** means bad and **"aria"** means air. For further clarification of the observation, some volunteers (رضاکار) drank the stagnant water from the marshes. They did not develop malaria.

Treatment of Malaria:

When the New World (America) was discovered, many plants from America were sent back to Europe to be used as medicines. The bark (چھال) of a tree known as **quina-quina** was very suitable for curing fevers. It was so beneficial that soon it was impossible to carry enough bark to Europe. Some dishonest merchants began to substitute the bark of another tree, **the cinchona** which closely resembled (مشابہ تھا) quina-quina. This dishonesty proved much valuable for mankind. The cinchona bark was found to be excellent (بہترین) for treating malaria as it contains quinine that is effective in treating the disease.

At that time, physicians treated malaria with cinchona without understanding the cause of malaria.

Two hundred years later, it was found that some diseases are caused by tiny (بہت ہی چھوٹے) living organisms. After this discovery, it also became a belief that malaria, too, might be caused by some microorganism (خوردبینی جراثیم).

In 1878, a French army physicians **Laveran** began to search for the cause of malaria. He took a small amount of blood from a malarial patient (مریض) and examined it under microscope. He noticed some tiny living creatures.

Two years later, another physician saw the same creatures in the blood of another malarial patient.

Three years later after the second discovery, the same creatures were observed for third time. The organism was given a name Plasmodium.

In the last part of the nineteenth century (صدی), many different causes of malaria were being suggested.

Problem 1: Cause of malaria:

1. Observations:

At that time, there were four major observations about malaria.

(i) Malaria and marshy areas have some relation.

(ii) Quinine is an effective (مؤثر) drug for treating malaria.

(iii) Drinking the water of marshes does not cause malaria.

(iv) Plasmodium is seen in the blood of malarial patients.

2. Hypothesis:

A scientist uses whatever information and observation he has and makes one or more hypotheses. The hypothesis is made in this case was:

"Plasmodium is the cause of malaria"

Scientist does not know whether his hypothesis is true or not, but he accepts (تسلیم کرتا ہے) it may be true and makes deductions.

3. Deduction:

One of the deductions from the above hypothesis was:

"If Plasmodium is the cause of malaria, then all person ill with malaria should have Plasmodium in their blood."

4. Experiments:

The next step was to test the deduction through experiments which were designed as;

"Blood of 100 malarial patients was examined under microscope. For the purpose of having a control group, the blood of 100 healthy (صحت مند) persons was also examined under microscope."

5. Results:

The results of the experiments showed that almost all malarial (ملیریائی) patients had

Plasmodium in their blood while 07 out of 100 healthy persons also had Plasmodium in their blood (now we know that Plasmodium in the blood of healthy people was in incubation (پرورش) period i.e., the period between the entry of parasite in host and appearance (ظاہر ہونا) of symptoms (علامات)).

6. ***Conclusion (نتیجہ):***

The results were quite convincing (حوصلہ کن) and proved that the hypothesis "Plasmodium is the cause (وجہ) of malaria" was true.

Problem 2: How plasmodium gets into the blood of man?

1. ***Observations:***

Biologists were having following important observations:

(i) Malaria is associated with marshes.

(ii) Drinking water of marshes does not cause malaria

It can be concluded that Plasmodium was not in the marsh water. But it must be carried by something that comes to marsh water.

In **1883**, a physician (ماہر طبیعات), **A. F. A. King**, listed 20 observations. Some important observations of King were:

(i) People who slept outdoors (باہر) were more likely to get malaria than those who slept indoors;

(ii) People who slept under fine nets (مچھر دانی) were less likely to get malaria than those who did not use such nets; and

(iii) Individuals who slept near a smoky (دھوئیں والی) fire usually did not get malaria.

2. ***Hypothesis:***

King suggested a hypothesis:

"Mosquitoes transmit Plasmodium and so are involved (ملوث ہیں) in the spread of malaria"

3. ***Deductions:***

Following deductions were made considering the hypothesis as true i.e. If mosquitoes are involved in the spread of malaria then;

"Plasmodium should be present in mosquitoes."

"A mosquito can get Plasmodium by biting a malarial patient"

4. ***Experimentation:***

In order to test the above deductions, **Ronald Ross**, a British (برطانوی) army physician working in India in 1880's, performed important experiments. He allowed a female ***Anopheles*** mosquito to bite a malarial patient. He killed the mosquito some days later and found Plasmodium multiplying mosquito's stomach.

The next logical experiment was to allow an infected mosquito (having Plasmodium) to bite a healthy person. If the hypothesis (مفروضہ) was true, the healthy person would have got malaria. But scientists avoid using human beings for experiments

when results can be so serious. Ross used sparrows (چڑیا) and redesigned his experiments. He allowed a female **Culex** mosquito to bite on the sparrows suffering from malaria. Some of the mosquitoes were killed and studied at various times. Ross found that Plasmodium multiplied in the wall of the mosquito's stomach and then moved into the mosquito's salivary glands. Female mosquitoes need the blood of mammals (دودھ پلانے والے جانور) or birds for the maturation of their eggs.

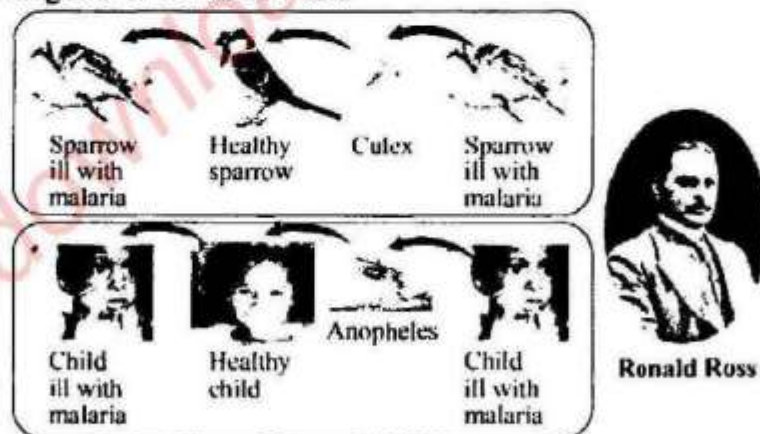
He kept some mosquitoes alive and allowed them to bite healthy sparrows.

5. Results:

Ross found that the saliva (لعاب) of the infected mosquito contained Plasmodia (plural of plasmodium) and these entered the sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many Plasmodia in it.

The hypothesis was at last tested by direct experimentation on human beings. In 1898, Italian biologists allowed an Anopheles mosquito to bite a malarial patient. The mosquito was kept for a few days and then it was allowed to bite a healthy man. This person later became ill with malaria.

6. Conclusion:

It was confirmed (تصدیق کی گئی) that mosquitoes transmit Plasmodium and spread malaria. When a female mosquito pierces the skin with her mouthparts, she injects a small amount of saliva into the wound before drawing blood. The saliva prevents the blood from clotting (جمنا) in her food canal.

Malaria in sparrow and man is transmitted by Culex and Anopheles mosquitoes respectively

2.1.2 THEORY, LAW AND PRINCIPLE

Q.5. Define the following terms:

i. Theory   ii.Law or Principle

Ans: i. Theory:

When a hypothesis is given a repeated (بار بار) exposure (سامنا) to experimentation

and is not falsified, it increases biologists' confidence in the hypothesis. Such well-supported hypothesis may be used as the basis (بنیاد) for formulating further hypotheses which are again proved by experimental results.

Definition:

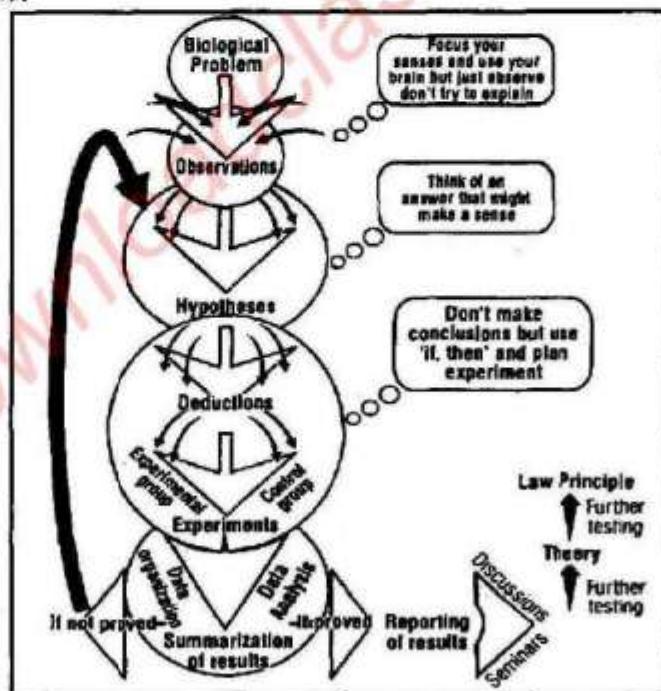
The hypotheses that stand the test of time (often tested and never rejected (مسترد کی گئی)), are called **theories**. A theory is supported by a great deal of evidence (شہادت).

ii. Law or Principle:

Productive theory keeps on suggesting new hypotheses and so testing goes on. Many biologists take it as a challenge and exert greater efforts to disprove the theory. If a theory survives such doubtful approach and continues to be supported by experimental evidence, it becomes law (قانون) or principle.

Scientific law:

A scientific law is a uniform or constant fact of nature. It is an irrefutable (ناقابل تردید) theory.

Examples: The examples of biological laws are Hardy-Weinberg law and Mendel's laws of inheritance (وراثت).

Biological Method

2.2 DATA ORGANIZATOIN AND DATA ANALYSIS

Q.6. What is data? How data can be organized and analyzed? What is its importance in biological method?

Ans: Data organization and data analysis are important steps in the biological method.

Data:

Data can be defined (تعریف کی جا سکتی ہے) as the information such as names, dates or values made from observations and experimentation.

Data Organization:

In order to formulate and then to test the hypotheses, scientists collect and organize data.

Prior to conducting an experiment, it is very important for a scientist to describe the data collection methods. It ensures the quality of the experiment.

Formates of Data:

Data is organized in different formats like graphics, tables, flow charts, maps and diagrams.

Data Analysis:

Data analysis is necessary to prove or disprove a hypothesis by experimentation. It is done through the application of statistical methods i.e. ratio and proportion (نسبت اور تناسب).

Ratio:

When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b), it is called the ratio of one number to the other. A ratio may be expressed by putting a division (÷) or colon (:) mark between the two numbers. For example the ratio between 50 malarial patients and 150 normal (عام) persons is **1:3**.

Proportion (نسبت):

Proportion means to join the two equal ratios by the sign of equality (=), For example; **a:b=c:d** is a proportion between the two ratios. This proportion may also be expressed as **a:b::c:d**.

When three values (قدریں) in a proportion are known, the fourth one (X) can be calculated.

Example: A biologist can calculate how many birds will get malaria when he allows infected mosquitoes to bite 100 healthy sparrows. In the previous (پچھلے) experiment he noted that when he allowed mosquitoes to bite 20 sparrows, 14 out of them got malaria. Now he uses the proportion rule.

1st Ratio 14 : 20 (14 out of 20) 2nd Ratio X : 100 (How many out of 100)	Proportion 14:20::X:100

$$\frac{X}{100}=\frac{4}{20}\rightarrow X\times 20 = 100\times 14\rightarrow X = \frac{100}{20}\times 14\rightarrow X = 70$$

It means 70 out of 100 sparrows would get malaria.

Statistics are thus a means of summarizing data through the calculation of a mean (اوسط) value. This step is very important as it transforms raw (خام) data into information, which can be used to summarize and report results.

2.3 MATHEMATICS AS AN INTEGRAL PART OF SCIENTIFIC PROCESS

Q.7. Justify (جواز پیش کریں) mathematics as an integral part of the scientific process.

Ans: ***Application (اطلاق) of Mathematics:***

Biological method also involves the use of applied mathematics to solve biological problems. Major biological problems in which knowledge of mathematics is used include gene finding, protein structure, and protein-protein interactions (باہمی تعامل) etc.

Bioinformatics:

Bioinformatics refers to the computational and statistical techniques for the analysis of biological data.

Review Questions

MULTIPLE CHOICE

1. Which one of the following is a correct sequence in biological method?
(a) Observations, Hypothesis, Law, Theory
(b) Hypothesis, Observations, Deduction, Experimentation
(c) Observations, Hypothesis, Deduction, Experimentation
(d) Law, Theory, Deduction, Observations

2. Which one of these is NOT a characteristic of a hypothesis?
(a) Must be consistent with all available data (b) Must be testable
(c) Must be correct (d) Must make predictions

3. At which point is a biologist most likely to use reasoning?
(a) While taking observations (b) During hypothesis formulation
(c) During data organization (d) None of the above

4. A hypothesis must be testable to be scientifically valid. Being testable means that __________.
(a) Some observation could prove the hypothesis incorrect
(b) Only a controlled experiment can indicate whether the hypothesis is correct or incorrect
(c) The hypothesis is proven wrong
(d) The opposite of hypothesis is tested and proven wrong.

5. What would be the best experimental design for testing a hypothesis that bean plants require sodium?

(a) Measure the amount of sodium in a few bean plants
(b) Grow bean plants with and without sodium
(c) Look for sodium in leaf tissues
(d) Analyze root contents for sodium

6. **A gardener sees a large snake nearby. He knows that generally snakes sting, so the gardener ran away. The gardener did which of the following?**
(a) Used reasoning (b) Used observation
(c) Constructed a theory (d) Tested a hypothesis

7. **A scientific theory has which of the following properties?**
(a) It agrees with available evidence
(b) It cannot be rejected
(c) It has been absolutely proven
(d) It does not need to be altered in the light of new evidence

8. **Experimentation is only a step of the scientific process, but it is a very important step because it always ________.**
(a) Gives the biologist a correct result
(b) Allows rejection of some alternative hypotheses
(c) Ensures that hypotheses can be confirmed with certainty
(d) Gives scientists a chance to work in the laboratory

9. **You are testing a hypothesis; "students learn more if they drink tea before sitting for study:" Your 20 experimental students drink tea before study; you test their learning by giving questions. Your 20 students of the control group should have all experimental conditions identical to the experimental group EXCEPT that;**
(a) They should take tea with more milk and sugar
(b) They should take tea before as well as during study
(c) They should not take tea before study.
(d) After taking tea they should not sit for study.

Ans: **1.** Observations, Hypothesis, Deduction, Experimentation
2. Must be correct **3.** During hypothesis formulation
4. The hypothesis is proven wrong **5.** Grow bean plants with and without sodium
6. Used reasoning **7.** It cannot be rejected
8. Allows rejection of some alternative hypotheses
9. After taking tea they should not sit for study.

UNDERSTANDING THE CONCEPTS

1. Describe the steps involved in biological method taking malaria as an example.

Ans: Refer to Q.No.3 for answer.

2. If a test shows that some people have Plasmodium in their blood but they do not show any symptoms of malaria, what hypothesis would you formulate to answer this problem?

Ans: Plasmodium may be present in healthy person during its incubation period, i.e. without any symptoms. Hypothesis could be:

Person with Plasmodium may develop malaria in next few days.

3. How the principles of ratio and proportion are used in biological method?

Ans: Refer to Q.No.6 for answer.

4. Justify mathematics as an integral part of the scientific process.

Ans: Refer to Q.No.7 for answer.

SHORT QUESTIONS

1. Differentiate between theory and law.

Ans. Theory: The hypotheses that often tested and never rejected is called theory. A theory is supported by a great deal of evidence.

Law: Law is a rule which predicts the same result when similar conditions are always satisfied.

2. Quantitative observations are better in biological method. How?

Ans. Quantitative observations are better in biological method because the former are invariable and measurable and can be recorded in terms of numbers.

THE TERMS TO KNOW

Bioinformatics:

Bioinformatics refers the computational and statistical techniques for the analysis of biological data.

Biological method:

The scientific method in which biological problems are solved, is termed as biological method.

Biological problem:

A query about life that is either asked by some one or comes in biologist's mind by

himself.

Control group:

One of the two groups in experiments; provided with the variable that has to be tested.

Deduction:

Deductions are the logical consequences of hypothesis.

Experiment:

The most basic step of biological method is experiment, Biologist performs experiment to see which hypothesis is correct.

Experimental group:

One of the two groups; not provided with the variable that has to be tested.

Hypothesis:

The tentative explanation of observations is called a hypothesis. It can be defined as a proposition that might be true.

Law:

A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

Observation:

Observation is the first step of the scientific method observations are made with five senses of vision, hearing, smell, taste and touch.

Theory:

The hypotheses that stand the test of time are called theories. Theory is often tested and never rejected.

INITIATING AND PLANNING

1. Identify and pose meaningful, answerable scientific questions.
2. For a given biological problem;
   (i) Formulate and test a working hypothesis.
   (ii) Write instructions for conducting investigations.
   (iii) Organize data appropriately using techniques such as tables and graphs.
   (iv) Analyze data to make predictions, decisions, or draw conclusions.
   (v) Confirm, modify, or reject a hypothesis using data analysis.
   (vi) Use ratio and proportion in appropriate situation to solve problems.

ON-LINE LEARNING

- en.wikipedia.org/wiki/scientific_method
- www.sciencebuddies.org/science-fair
- www.visionlearning.com/library
- www.scientificmethod.com/www.scientificmethod.com

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS
(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **Malaria is caused by:** (LHR. GI, SGD. GII, FBD. GI, DGK. GI)
   (A) Plasmodium (B) Entamoeba (C) Paramecium (D) E-Coli
2. **A Physician A.F.A King listed 20 observations in:** (LHR. GII, GRW. GI)
   (A) 1884 A.D. (B) 1883 A.D. (C) 1882 A.D. (D) 1885 A.D.
3. **A litre of water weighs _________.** (GRW. GII)
   (A) 1000 g (B) 789 g (C) 900 g (D) 979 g
4. **The hypothesis that stand the test of time are called:** (FBD. GI, GRW. GI)
   (A) Theories (B) Laws (C) Deductions (D) Experiments
5. **The tentative explanation of observation is called:** (FBD. GII, DGK. GI)
   (A) Deductions (B) Theory (C) Hypothesis (D) Experiments
6. **The most basic step of Biological method is:** (MLN. GI)
   (A) Experimentation (B) Observations
   (C) Deductions (D) Hypothesis
7. **The bark of _______ tree was found very suitable for curing malaria.** (LHR. GI, MLN. GII)
   (A) Cedrus (B) Cinchona (C) Pinus (D) Cactus
8. **The scientific method in which biological problems are solved is called:** (SGD. GI)
   (A) Geological problem (B) Biological method
   (C) Non-biological method (D) All of these
9. **Plasmodium is transfered by:** (SGD. GII)
   (A) Fly (B) Virus (C) Mosquito (D) Bacteria
10. **The logical results of hypothesis are called:** (RWP. GI, SGD. GII, RWP. GII, DGK. GII)
    (A) Law (B) Deduction (C) Experiment (D) Problem
11. **"Plasmodium is the cause of malaria". This statement is a:** (RWP. GII)
    (A) Hypothesis (B) Deduction (C) Theory (D) Law
12. **Anopheles mosquito causes a disease:** (DGK. GII)
    (A) Dengue Fever (B) Malaria Fever (C) Typhoid Fever (D) Flu Fever
13. **Man always remained a:** (BWP. GI)
    (A) Chemist (B) Biologist (C) Geologist (D) Scientist

14. It is an effective drug for treating Malaria: (BWP. GII)
(A) Disprein (B) Actified (C) Quinine (D) Theragram

15. Which one of the characteristic is not in a good hypothesis? (LHR. GII)
(A) Must be consistent with available data (B) Must be testable
(C) Must be correct (D) Must make prediction

16. At which point is a biologist most likely to use reasoning? (FBD. GII)
(A) While taking observation (B) During hypothesis formulation
(C) During data organization (D) Reporting the results

17. Female mosquitoes need the blood of _____ for the maturations of their eggs: (MLN. GI)
(A) Mammals (B) Birds (C) Both A and B (D) Reptiles

18. Biological Method comprises of _________ steps. (MLN. GII)
(A) 5 (B) 6 (C) 7 (D) 8

19. The bark of which plant contains Quinine? (SWL. GI)
(A) mango tree (B) pinus (C) quina quina (D) guava tree

20. Cinchona bark contains: (SWL. GII)
(A) Quinine (B) quina quina (C) resochine (D) basoquine

21. French Army Physician who worked on malaria in 1878. (SGD. GI)
(A) Laveran (B) Ronald Ross (C) A.F.A King (D) Mendel

22. The malaria is spread in birds by: (RWP. GI)
(A) Anopheles (B) Dengue (C) Aedes (D) Culex

23. The logical consequences of hypothesis is called: (RWP. GII)
(A) Hypothesis (B) Observations (C) Law (D) Deduction

24. The number of organisms on Earth is: (DGK. GII)
(A) 10 thousand (B) Two lac (C) 20 Lac (D) One crore

25. In Sparrows, Malaria is spread by: (BWP. GI)
(A) Culex Mosquito (B) Anopheles Mosquito
(C) Marshy Areas (D) Virus

26. Ronald Ross performed experiments in: (BWP. GII)
(A) 1878 (B) 1880 (C) 1855 (D) 1888

Answers

1. Plasmodium	2. 1883 A.D.	3. 1000 g	4. Theories
5. Hypothesis	6. Experimentation	7. Cinchona	8. Biological method
9. Mosquito	10. Deduction	11. Law	12. Malaria Fever
13. Biologist	14. Quinine	15. Must be correct	
16. During hypothesis formulation		17. Both A and B	18. 6
19. quina quina	20. Quinine	21. Laveran	22. Aedes
23. Deduction	24. One crore	25. Culex Mosquito	26. 1880

☆ **Give short answer to the following questions.**

1. **Write the role of control group in experiments.**

(LHR. GI, FBD. GI & GII, MLN. GII, RWP. GII)

Ans: In science when doing the experiment, it must be a controlled experiment. The scientist must contrast an "experimental group" with a "control group". The two groups are treated exactly alike except for the one variable being tested. For example, in an experiment to test the necessity of carbon dioxide for photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide) with an experimental group (a plant with no carbon dioxide available). The necessity of carbon dioxide will be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

2. **Describe two observations of A.F.A King about malaria.**

(LHR. GII, GRW. GII, MLN. GI)

Ans: Some important observations of A. F. A. King were:

1. People who slept outdoors were more likely to get malaria than those who slept indoors.
2. People who slept under fine nets were less likely to get malaria than those who did not use such nets.

3. **Describe the meaning of words "mala" and "aria".** (LHR. GII)

Ans: The word 'malaria' is derived from two Greek words. 'Mala' means 'bad' and 'aria' means 'air' i.e. disease of bad air.

4. **Why Ronald Ross used sparrow in his experiment?** (GRW. GI)

Ans: Scientist used other animals for experiment instead of human beings the reason is that the results of experiments may be hazardous which can harm them.

5. **Why quantitative observations are better in biological method?**

(GRW. GI, MLN. GII, RWP. GI, LHR. GII)

Ans: Quantitative observations are better in biological method because the former are invariable and measurable and can be recorded in terms of numbers.

6. **Give two examples of qualitative observations.** (GRW. GII)

Ans:
1. The freezing point of water is colder than the boiling point.
2. On liter of water in heavier than one liter of ethanol.

7. **What is meant by biological problem?** (FBD. GI, SGD. GI)

Ans: A query about life that is either asked by some one or comes in biologist's mind by himself is called biological problem.

8. **What is the relation of quina quina with cinchona?** (FBD. GI)

Ans: When the New World (America) was discovered, many plants from America were sent back to Europe to be used as medicines. The bark of a tree known as quina-quina was very suitable for curing fevers. It was so beneficial that soon it was

impossible to carry enough bark to Europe. Some dishonest merchants began to substitute the bark of another tree, the cinchona which closely resembled quina-quina. This dishonesty proved much valuable for mankind. The cinchona bark was found to be excellent for treating malaria as it contains quinine that is effective in treating the disease.

9. How a hypothesis formulate? (FBD. GII)

Ans: Biologist organizes observations into data form and constructs a statement that may prove to be the answer of the biological problem under study. This tentative explanation of the observations is called a hypothesis, It may be defined as a proposition that might be true.

10. Define Biological Method. (MLN. GI, DGK. GI, BWP. GI)

Ans: The scientific method in which biological problems are solved, is termed biological method.

11. Write two examples of Biological Laws. (MLN. GI)

Ans: Hardy wein Berg law, and Mendel law are examples of biological laws.

12. Differentiate between qualitative and quantitative observations. (SWL. GI, MLN. GI)

Ans: Qualitative observations are those which are variable and are not measurable. These are recorded in terms of conditions for example one liter of water is heavier than one liter of ethanol, while quantitative observations are invariable and measurable, and can be recorded in terms of numbers. For example the freezing point of water is 0 °C and boiling point is 100 °C.

13. Define law or principle. (SWL. GII)

Ans: If a theory survives such doubtful approach and continues to be supported by experimental evidence it becomes law. A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

14. What is meant by bioinformatics? (SWL. GII)

Ans: Bioinformatics refers the computational and statistical techniques for the analysis of biological data.

15. Define scientific method. (SGD. GII, DGK. GI, RWP. GI)

Ans: As the science is an organized knowledge obtained from different observations and experiments carried out to determine the principles about how the nature works. Chemists, biologists, ecologists and physicist, all use the same scientific method to make and test new theories.

16. What is meant by productive theory? (SGD. GII)

Ans: A theory is supported by a great deal of evidence. Productive theory keeps on suggesting new hypothesis and so testing goes on many biologist take it as challenge and exert greater efforts to disprove the theory.

17. Write down the contributions of French Army Physician Laveran. (RWP. GI)

Ans: In 1878, a French army physicians Laveran began to search for the cause of malaria. He took a small amount of blood from a malarial patient and examined it under microscope. He noticed first about some tiny living creatures in blood of patients.

18. What is difference between theory and Law? (LHR. GI & GII, SWL. GI, RWP. GII, DGK. GI, GRW. GII)

Ans: Theory: The hypothesis that often tested and never rejected is called theory. A theory is supported by a great deal of evidence.

Law: Law is a rule which predicts the same result when similar conditions are always satisfied.

19. Give two examples of quantitative observation. (DGK. GII)

Ans: Examples of quantative observations are:

The freezing point of water is 0°C and the boiling point is 100°C.

20. What were the four major observations of Malaria in the last part of 19th Century? (OR)Write two observations about Malaria. (FBD. GI, BWP. GI)

Ans: At that time, there were four major observations about malaria.

1. Malaria and marshy areas have some relation.
2. Quinine is an effective drug for treating malaria.
3. Drinking the water of marshes does not cause malaria.
4. Plasmodium is seen in the blood of malarial patients.

21. What is meant by hypothesis? (GRW. GI, SWL. GI, BWP. GII)

Ans: The tentative explanation of observation is called hypothesis.

22. Differentiate between culex and anopheles mosquitoes. (GRW. GII)

Ans:

Culex	Anopheles
☆ Culex have unspotted wings.	☆ Anopheles have spot on their wings.
☆ Eggs are laid in cluster.	☆ It laid eggs singly.
☆ Culex feed below water surface.	☆ Anopheles feed on water surface.

23. Define Ratio and Proportion. (BWP. GII, MLN. GII)

Ans: When a relation between two numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b), it is called ratio. It may be represent by a colon(:) or division(÷) while proportion means to join two equal ratio by the sign of equality(=) e.g. a:b = c:d.

24. What is incubation period? (SWL. GI)

Ans: The gap between a parasite on entering in a host and appearance of symptoms of diseases is known as incubation period.

25. How the reporting of results is done? (RWP. GII, SWL. GII)

Ans: Biologists publish their findings in scientific journals and books, in talks at national and international meetings and in seminars at colleges and universities.

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

26. How deductions are formed? Give an example. (SGD. GI, MLN. GII, DGK. GI)

Ans: The logical consequences of hypothesis is called deduction. The deduction involve the use of if-then logic.

Example: Following deductions were made considering the hypothesis as true i.e. If mosquitoes are involved in the spread of malaria then; "Plasmodium should be present in mosquitoes", "A mosquito can get plasmodium by biting a malarial patient".

27. Give an example of qualitative observations and quantitative observations. (SGD. GI)

Ans: **Example of qualitative observations:** The freezing point of water is colder than the boiling point is an example of qualitative observation.

Example of quantitative observations: 1 liter of water weighs 1000 gram and a liter of ethanol weighs 789 grams.

28. What was the name of first medicine for malaria curing? (RWP. GI)

Ans: In first quina-quina medicine is used to cure malaria.

29. Write four characteristics of a good hypothesis. (LHR. GI, RWP. GII)

Ans: A good hypothesis should have the following characteristics.

(a) It should be a general statement.
(b) It should be a tentative idea.
(c) It should agree with available observations.
(d) It should be kept as simple as possible.

30. Write down names of different steps. Involved in solving biological problem. (BWP. GI)

Ans: In solving a biological problem, biologist takes following steps:

1. Recognition of biological problem
2. Observations
3. Hypothesis formulation
4. Deductions
5. Experimentation
6. Summarization of results (create table, graphics etc)
7. Reporting the results

BIODIVERSITY

Major Concepts:

- **3.1-Biodiversity**
- **3.2-Classification – aims and principles**
- **3.3-History of classification system**
  - 3.1.1- Two-kingdom classification system
  - 3.1.2- Three-kingdom classification system
  - 3.1.3- Five-kingdom classification system
- **3.4-The Five kingdoms**
- **3.5-Binomial Nomenclature**
- **3.6-Conservation of biodiversity**
  - 3.6.1- Impact of human beings on biodiversity
  - 3.6.2- Deforestation
  - 3.6.3- Steps for the conservation of biodiversity
  - 3.6.4- Endangered species in Pakistan

3.1 BIODIVERSITY

Q.1. Define biodiversity. Relate the importance of biodiversity with natural (قدرتی) ecosystem through examples.

Ans: At least 10 million kinds of organisms inhabit (رہتے ہیں) the Earth but less than one third of these have been studied by biologists.

Diversity among the Earth's organisms is more obvious (ظاہر ہے) than the fundamental unity of life.

The five principal groups of organisms are **prokaryotes, protists, fungi, plants** and **animals.**

Biodiversity:

The term "biodiversity" has been derived (اخذ کیا گیا ہے) from 'bio' and 'diversity'.

"The biodiversity of an ecosystem can be defined as variety (اقسام) within a species and among species."

Biodiversity is a measure of the variety of organisms present in different ecosystems.

Factors (عوامل) Affecting the Biodiversity:

Biodiversity depends on some environmental (ماحولیاتی) factors, such as:

- Climate
- Altitude
- Soils
- Presence of other species

Biodiversity is not distributed evenly (برابر) on Earth. It is the richest in the tropics.

Temperate regions also have many species while there are fewer species in the polar regions.

Variety of plant life in a tropical (left) and temperate (right) region

Variety of animal life in polar region

Reason of biodiversity:

Living organisms found on Earth today is the result of 4 (چار ارب) billion years of evolution (ارتقا). The origin of life is not well known to science, though limited (محدود) evidence suggests that until 600 million years ago, all life consisted of bacteria and similar unicellular organisms.

Importance of biodiversity:

Biodiversity is very important in following ways:

1. ***Source of food:***

   Biodiversity provides food for humans.

2. ***Source of drugs:***

- We get a significant proportion of drugs (ادویات) from biological sources directly (بلا واسطہ) or indirectly (بالواسطہ).

3. ***Source of industrial materials:***

   A wide range of industrial materials e.g. building materials, fibres, dyes, resins (گوند)

(بیروزہ, gums, adhesives, rubber and oil are derived (لئے جاتے ہیں) directly from plants.

4. ***Importance in Ecosystem:***

Biodiversity plays important role in making and maintaining ecosystems.

5. ***Regulation in Environment:***

Biodiversity plays a part in regulating (باقاعدہ بنانا) the chemistry of our atmosphere and water supply.

6. ***Recycling of nutrients:***

Biodiversity is directly involved in recycling (دوبارہ کارآمد بنانا) nutrients and providing fertile (زرخیز) soils.

3.2 CLASSIFICATION - AIMS AND PRINCIPLES

Q.2. Define the term classification (درجہ بندی). What are its aims, basis and principles?

Ans: CLASSIFICATION:

Definition:

Categorization of living organisms by biologists into groups and sub groups on the basis of their similarities (مشابہت) and dissimilarities (غیر مشابہت) is called classification.

Explanation:

There is a large collection (مجموعہ) of very dissimilar forms of organisms, found on Earth.

Number of Organisms:

On Earth, over 1.5 million types of animals and over 0.5 million types of plants are known to biologists.

Complexicity:

Animals range in complexity (پیچیدگی) from small and simple bacteria to large and complex human beings.

Habitat (مسکن) and feature:

Some of them live in sea, some on land; some walk, others fly, and still others are stationary.

General Characteristics:

Each animal has its own way of life i.e. getting food, avoiding unfavourable environmental conditions, finding a place to live, and reproducing (افزائش نسل) its kind.

When we realize that there are so many diverse kinds of organisms, it becomes difficult to learn about the characteristics of each.

Taxonomy:

The branch of biology which deals with classification is called taxonomy (صنف بندی).

Systematics:

The branch which deals with classification and also traces the evolutionary history

of organisms is known as sys ematics (تقسیم و ترتیب کا اصولی مطالعہ).

Aims of Classification:

The main aims of taxonomy and systematics are.

(i) To determine similarities and differences among organisms so that they can be studied easily.

(ii) To find the evolutionary relationships (ارتقائی تعلق) among organisms.

Basis of Classification:

Similarities in characters:

Classification is based on relationship amongst organisms and such relationship is got through similarities in characteristics (خاصیتیں). These similarities suggest that all organisms are related to one another at some point in their evolutionary histories. However, some organisms are more closely related than others.

Example: Sparrows are more closely related to pigeons (کبوتروں) than to the insects. It means that the former two have common evolutionary histories.

Biologists have classified all the known organisms into groups and subgroups on the basis of similarities.

Study of DNA:

Modern genetics provides another type of information to taxonomists. The similarities and differences in the DNA of the studied organisms can be used for getting idea about similarities and differences in their structures (ڈھانچے) and functions.

Taxonomic Hierarchy:

The groups into which organisms are classified are known as taxonomic categories or taxa (singular "taxon") and these taxa form a ladder, called **taxonomic hierarchy**. All the organisms are divided into five kingdoms. Then, on the basis of similarities, each kingdom is further divided (تقسیم در تقسیم) into smaller taxa in the following way:

(i) **Phylum** (Division: for plants and fungi): A phylum is a group of related classes.

(ii) **Class:** A class is a group of related orders.

(iii) **Order:** An order is a group of related families.

(iv) **Family:** A family is a group of related genera.

(v) **Genus:** A genus is a group of related species.

(vi) **Species:** A species consists of similar organisms.

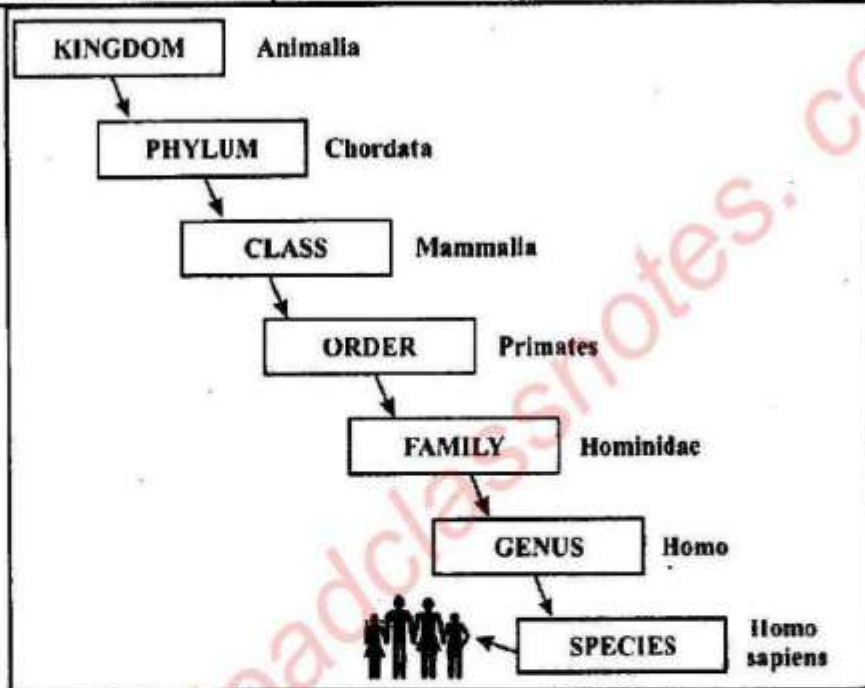
Members of lower taxon resemble one another more than do the members of a higher taxon.

Table illustrates the classification of humans (Homo sapiens) and pea.(Pisum sativum).

Table: Simple classification of five representative organisms

Taxa	Human	Pea
Kingdom	Animalia	Plantae
Phylum	Chordata	Magnoliophyta
Class	Mammalia	Magnoliopsida

Order	Primates	Fabales
Family	Hominidae	Fabaceae
Genus	*Homo*	*Pisum*
Species	*H. sapiens*	*P. sativum*

KINGDOM — Animalia
PHYLUM — Chordata
CLASS — Mammalia
ORDER — Primates
FAMILY — Hominidae
GENUS — Homo
SPECIES — Homo sapiens

Taxonomic hierarchy

Species - The Basic Unit of Classification:

Definition:

Species is the basic unit (بنیادی اکائی) of classification. "A species is a group of organisms which can interbreed (دوغلی ملاپ) freely among them and produce fertile offspring, but are reproductively isolated from all other such groups in nature. "Each species possesses its own distinct (نمایاں) structural, ecological (ماحولیاتی) and behavioural characteristics.

In the definition of species we must emphasize "in nature" because two organisms related to two different but closely related species can cross-breed under artificial conditions. In such unnatural crosses they produce infertile offspring.

Example: A cross between a male donkey and female horse produces as infertile offspring, i.e. the mule (خچر).

Mule produced through an unnatural cross between a male donkey and a female horse

Q.3. Write a note on historical background of classification.

Ans: HISTORY OF CLASSIFICATION SYSTEMS:

Work of Aristotle: Aristotle (ارسطو), a Greek (یونانی) philosopher, provided the earliest known system of classification of organisms. He proposed (تجویز کیا) two-kingdom system of classification.

a. Kingdom Animalia
b. Kingdom Plantae

1. **Work of Abu-Usman Umer Aljahiz:** Abu-Usman Umer Aljahiz, in 700s, described the characteristics of 350 species of animals in his book. He wrote a lot about the life of ants (چیونٹیاں).
2. **Work of Ibn Rushd:** In 1172, Ibn Rushd (Averroes), translated Aristotle's book "de Anima (On the Soul)" in Arabic.

Modern Period:

In the end of 15th century, many biologists had started work on classification methods.

3. **Work of Andrea Caesalpino (1519-1603 AD):** He divided plants into fifteen groups called "genera".
4. **Work of John Ray (1627-1705 AD):** John Ray published important works on plant's classification.
5. **Work of Augustus Rivinus (1652-1723 AD)** He introduced the taxon of 'order'.
6. **Tournefort (1656-1708 AD)** He introduced the taxa of "class" and "species."
7. **Work of Carolus Linnaeus (1707-1778 AD):** Carolus Linnaeus, grouped species according to similar physical characteristics (مشابہ طبعی خاصیتیں).

Q.4. Explain the reasons for establishing five kingdoms of living organisms.

Ans: Biologists prefer such a system that can provide maximum information about the basic differences and similarities among different organisms.

According to earlier classification systems, organisms were classified into two kingdoms but now taxonomists agree on five-kingdom classification system.

TWO KINGDOM CLASSIFICATION SYSTEM:

This oldest system classifies all organisms into two kingdoms:

1. Kingdom Plantae 2. Kingdom Animalia

1. ***Kingdom Plantae:***

(i) According to it, all organisms that can prepare food from simple inorganic materials and thus can store energy, are autotrophs and are included (شامل ہیں) in kingdom plantae.

(ii) According to this system, bacteria, fungi and algae were included in kingdom

plantae.

2. ***Kingdom Animalia:***

On the other hand, the organisms that cannot synthesize their food and depend on autotrophs (غیر نامیاتی مادوں سے پیچیدہ غذائی نامیاتی مادے بنانے والے) or others are heterotrophs (اپنی غذا اور کاربن نامیاتی جسموں سے حاصل کرنے والے) and are included in kingdom animalia.

Drawbacks (خامیاں):

Some taxonomists found this system unworkable due to following reasons:

(a) Many unicellular organisms like Euglena have both plant-like (presence of chlorophyll) and animal-like (heterotrophic mode of nutrition in darkness and lack of cell wall) characters. So there should be a separate kingdom for such organisms.

(b) This system also ignores (نظرانداز کرتا ہے) the difference between organisms having prokaryotic and those having eukaryotic cells.

THREE-KINGDOM CLASSIFICATION SYSTEM:

Three kingdom system of classification was proposed by **Ernst Hackel in 1866.** He solved the first objection and proposed kingdom Protista to accommodate euglena-like organisms. He also included bacteria in kingdom Protista.

Drawbacks:

Drawbacks of this system were:

(a) In this system, fungi were still included in the kingdom plantae.

(b) This system did not clear the difference between prokaryotes and eukaryotes.

Objections of some biologists:

Some biologists disagreed about the position of fungi in kingdom plantae. Fungi resemble plants in many ways but are not autotrophs. They are special form of heterotrophs that get their food by absorption. They do not have cellulose in their cell walls rather possess chitin (ایک شکری مرکب).

In 1937, **E-Chatton** suggested the terms of, "Procariotique" to describe bacteria and "Eucariotique" to describe animal and plant cells.

FIVE KINGDOM CLASSIFICATION SYSTEM:

In 1967, **Robert Whittaker** introduced (متعارف کروایا) the five-kingdom classification system. This system is based on:

(i) The levels of cellular organization i.e. prokaryotic, unicellular eukaryotic and multicellular eukaryotic.

(ii) The principal modes of nutrition i.e. photosynthesis, absorption, and ingestion.

On these basis, organisms are classified into five kingdoms:

1. Monera 2. Protista 3. Fungi 4. Plantae 5. Animalia

In 1988, **Margulis** and **Schwartz** modified (تبدیل کیا) the five-kingdom classification of Whittaker by considering cellular organization and mode of nutrition. They classified

the organisms into the same five kingdoms as proposed by Whittaker.

3.4 THE FIVE KINGDOMS

Q.5. What are the general characteristics of five kingdoms proposed by Margulis and Schwartz?

Ans: The general characteristics of the five kingdoms are as follows:

1. Kingdom monera:

- It includes prokaryotic organisms i.e. they are made of prokaryotic cells.
- Monerans are unicellular, although some types form chains (زنجیری شکل), clusters (گچھے), or colonies of cells.
- Most are heterotrophic but some perform photosynthesis because they have chlorophyll in their cytoplasm.
- Within this kingdom, there are two different kinds of organisms i.e. bacteria and cyanobacteria.
- Prokaryotic cells are radically different from eukaryotic cells.

2. Kingdom protista:

It includes eukaryotic, unicellular and simple multicellular organisms. There are three main types of protists.

(i) Plant-like protists:

Algae are unicellular (ایک سیل رکھنے والا), colonial or simple multicellular. They resemble plant cells with cell walls and chlorophyll in chloroplasts. Simple multicellular means that they do not have multicellular sex organs and do not form embryos during their life cycles.

(ii) Animal-like protists:

Protozoans resemble animals whose cells lack (کمی ہونا) chlorophyll and cell walls.

(iii) Fungi-like protists:

Some protists are like the fungi.

3. Kingdom fungi:

- It includes eukaryotic multicellular heterotrophs, for example, mushrooms.
- Fungi are absorptive in their nutritional mode.
- Most fungi are decomposers. They live on organic material, secrete (خارج کرتے ہیں) digestive enzymes and absorb small organic molecules formed by the digestion by enzymes.

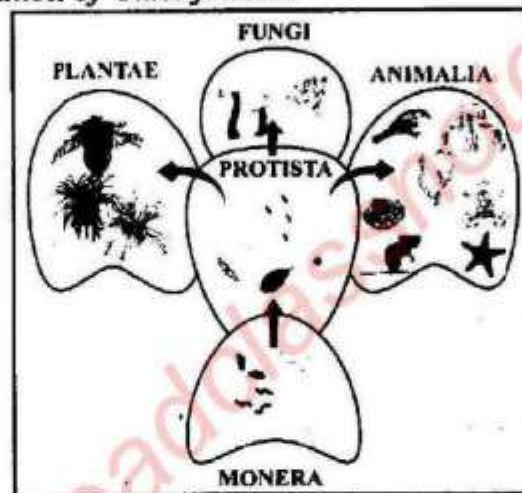
4. Kingdom plantae:

- It includes eukaryotic multicellular autotrophs.
- Plants make their own food by photosynthesis.
- They have multicellular sex organs.
- They form embryos during their life cycles.

- Mosses (کائیاں), ferns and flowering plants are included in this kingdom.

5. *Kingdom animalia:*

- It includes eukaryotic multicellular organisms.
- They are heterotrophs and hence consumers.
- Animals live mostly by ingesting (نگلنا) food and digesting (ہضم کرنا) it within specialized cavities (خانوں).
- They lack cell wall.
- They show movements.

Diagramatic Representation of Classification

The Five Kingdoms of classification

Biologists believe that kingdom protista evolved from monera and then it gave rise (سبب بننا) to the other 3 eukaryotic organisms. i.e fungi, plantae, animalia.

Table: Distinguishing characteristics of the five kingdoms of life

Kingdom	Cell Type	Nuclear Envelope	Cell Wall	Mode of Nutrition	Multi Cellularity
Monera	Prokaryotic	Absent	Non-cellulose (polysaccharide plus amino acids)	Autotrophic or heterotrophic	Absent
Protista	Eukaryotic	Present	Present in some forms, various types	Photosynthetic or heterotrophic, or combination	Absent in most forms
Fungi	Eukaryotic	Present	Chitin	Absorptive heterotroph	Present in most forms
Plantae	Eukaryotic	Present	Cellulose and other polysaccharides	Photosynthetic	Present in all forms
Animalia	Eukaryotic	Present	Absent	Ingestive heterotroph	Present in all forms

Q.6. Justify why viruses are excluded from the five-kingdoms?

Ans: ***Status (اہمیت) of Viruses:***

- Viruses are acellular i.e. they do not have cellular organization. Viruses are not considered as organisms and thus are not included in the five-kingdom classification system.

Characters of virus:

- Viruses show some characters of living organisms and also show some characters of non-living organisms.

Characters of living organism:

- Viruses contain either RNA or DNA, normally encased (لپٹے ہوئے ہیں) in protein coat.
- They reproduce only in living cells, where they cause a number of diseases.

Characters of non living organism:

- Viruses due to their crystalline (قلمی) nature are considered as non-living.

Q.7. What are prions and viroids?

Ans: ***Prions:***

Prions are composed of protein only and act as infectious particle in plants. Prions cause infectious diseases in certain plants.

Viroids:

Viroids are composed of circular (دائروی) RNA only and act as infectious (متعدی) particles, cause diseases in certain plants.

3.5 BINOMIAL NOMENCLATURE

Q.8. Describe the aims (مقاصد) and principles (اصول) of binomial nomenclature. Also write its significance (اہمیت).

Ans: BINOMIAL NOMENCLATURE:

Binomial nomenclature is the method of giving scientific names to living organisms. Swedish biologist Carolus Linnaeus (1707-1778 AD) first introduced and adopted (اختیار کیا) the system of binomial nomenclature. His system spread rapidly (تیزی سے) and became popular. Many of his names are in use today. In binomial nomenclature, as the word "binomial" suggests, the scientific name of a species consists of two names:

The first is the **genus name.**

The second is the **species name.**

Principles:

Binomial nomenclature follows some universally adopted (عالمی طور پر تسلیم شدہ) rules while suggesting and documenting scientific names.

(i) Scientific names are usually printed in italics (ترچھے), such as *Homo sapiens*. When handwritten they are underlined.

(ii) The first **term (generic name) always begins with capital letter,** while species name is never **capitalized** (even when **derived from a proper name).**

(iii) The scientific name is generally written in full when it is first used. But when several species from the same genus are being listed, it may then be abbreviated (مخفف کیے جاتے) by just using an initial for the genus; for example *Escherichia coli* becomes E.coli.

(iv) Sometime organisms are named in honor of (اعزاز کے طور پر) the research workers who described and classified them. For example the Orchid tree (Mountain- ebony) was named as *Bauhinia variegata* after the Swiss botanists Bauhin. *Bauhinia variegata* is an ornamental (آرائشی) tree found in southeast Asia. It is called **kachnar** in local language.

Significance:

In biological research, common names cause many problems. Various regions have different names for the same organism.

Example # 1:

The common name of onion in Urdu is **'Piyaz'** but in different regions of Pakistan it is also known as **'ganda'** or **'bassal'** or **'vassal'**. In other countries it has other sets of names.

In science, it is known with a single name as *Allium cepa*.

Example # 2:

In some cases, several different organisms are called by the same common name, the name of **'black bird'** is used for crow as well as for raven.

Example # 3:

Common names have no scientific basis. For example; a fish is a vertebrate animal with fins and gills. But several common names of **'silver fish', 'cray fish', 'jelly fish',** and **'star fish'**, do not fit the biologist's definition of a fish.

To avoid such confusions (مغالطے), organism are given scientific names by using binomial nomenclature.

The value of this system is due to its widespread use and the stability (مستقل پن) of its names. In binomial nomenclature, every species can be identified with just two words. The same name can be used all over the world, in all languages, avoiding difficulties of translation.

Examples:

Common Name	Scientific Name
Onion	*Allium cepa*
Common sea star (Star fish)	*Asterias rubens*
House crow	*Corvus splendens*

3.6 CONSERVATION OF BIODIVERSITY

Q.9. What do you mean by extinct (معدوم) and endangered (خطرے میں گھرے ہوئے) species?

Ans: EXTINCT AND ENDANGERED SPECIES:

Many species and ecosystems are threatened with destruction (تباہی) to an extent rarely (بہت کم) seen in Earth history by human activities.

Extinct Species:

A species that no longer lives in an ecosystem is said to be extinct in that ecosystem. When species of an ecosystem become extinct, the stability of ecosystem is harmed. Biologists warn that global ecosystem would collapse (ختم ہو جائے گا) if biodiversity continues to be reduced at the same rate.

A species is called extinct when there is no doubt that the last individual of that species has died, in ecosystem.

Endangered Species:

A species is called endangered when it is at risk of extinction in near future (مستقبل قریب میں).

Examples of extinct and endangered species:

Many plants and animal species have gone extinct in Pakistan.

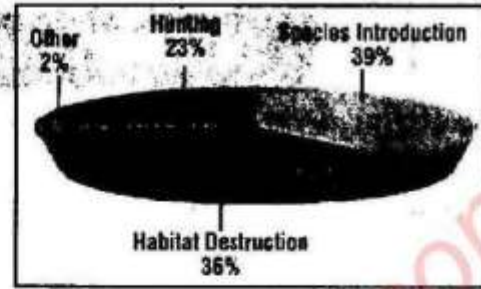
Examples of endangered and extinct animal species are lion, tiger, Asiatic cheetah, Indian one-horned rhinoceros, swamp deer, hangul, Indian wild ass, blackbuck etc.

The animals that have gone extinct in Pakistan.

3.6.1 IMPACT OF HUMAN BEINGS ON BIODIVERSITY

Q.10. Explain the impact (اثر) of human beings on biodiversity.

Ans: HUMAN IMPACT ON BIODIVERSITY:

Human Population: By 10,000 years ago there were about 5 million (پچاس لاکھ) people on Earth. The human population is growing rapidly with the advancement (ترقی) in agriculture and industry. Today around 6000 million people live on Earth. More than 260,000 people are added to the world population each day, or more than 180 each minute.

Known causes of species extinctions
(Source: World Conservation Monitoring Centre)

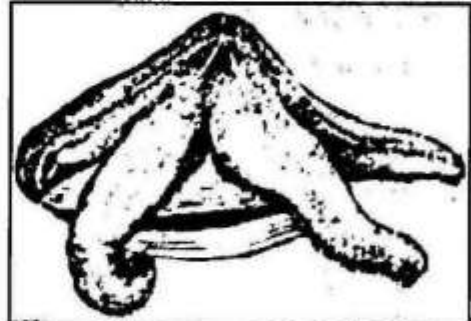
Threats imposed on biodiversity:

To improve the living conditions for 6000 million humans, we are imposing following serious threats to the survival of biodiversity.

1. Habitat loss (جانوروں کے مسکن تباہ کرنا).
2. Deforestation (جنگلات ختم کرنا).
3. Over-hunting.
4. Introduction or removal of species.
5. Pollution and climate change.

Above all are the major causes of species extinction.

INTERESTING INFORMATION

1. Sea star (starfish) eats mussels (سمندری گھونگا). If sea stars are removed from a region in ocean, mussels rapidly increase in number. Large number of mussels prey on small animals and become dangerous for their existence.

2. Eucalyptus plants were imported (درآمد کیے گئے) from Australia and introduced in Pakistan. These plants consume more water and have disturbed the water table (level of underground water). It harms other small plants that grow near Eucalyptus trees.

3.6.2 DEFORESTATION AND OVER-HUNTING

Q.11. Define deforestation. What are its causes and effects?

Ans: DEFORESTATION:

Definition: Deforestation means cutting down of trees for the conversion (تبدیل کرنا) of a forest to non-forest land.

Degraded environment:

The destruction of significant areas of forest has resulted in a degraded environment with reduced biodiversity.

Causes of Deforestation:

1. Deforestation is done for using the land for various purposes such as pasture (چراگاہ), urban use, etc.
2. The race to produce cash through fruits, spices, sugar, tobacco, soap, rubber, paper and cloth has stimulated (ترغیب دی ہے) many to get them by using soil and by destroying the forests.
3. Sometimes there is slow forest degradation and sometime sudden (اچانک) and catastrophic clear-cutting for urban development.
4. Deforestation can be the result of the deliberate removal of forests for wood, agriculture or urban development.

Effects of Deforestation:

1. ***Income loss:***

Short-term economic gains made by conversion of forest to agriculture often leads to loss of long-term income.

2. ***Deficiency (کمی) of water:***

Deforestation affects the amount of water in the soil and the moisture (نمی) in the atmosphere.

3. ***Reason of soil erosion (کٹاؤ):***

When there are no trees to keep the soil in place, the soil becomes exposed for erosion. Heavy rainfall washes the soil into rivers. Essential nutrients are washed out of soil.

4. ***Choking (رکاوٹ آنا) of rivers:***

Rivers become choked up with mud and silt, which can cause floods.

5. ***Reduce water storage capacity of dams:***

The silted water gets stored in dams and it reduces their water storage capacity (گنجائش).

6. ***Less rainfall:***

Deforestation also contributes to decrease transpiration, which lessens cloud formation. This ultimately reduces the sources of rains.

Soil erosion

Chopping up of trees for the construction of road

Q.12. How forests are advantageous (فائدہ مند) for mankind?

Ans: Forests and Mankind:

Forests are important for mankind in following ways;

1. **Habitat for Organisms:** Forests support considerable biodiversity, providing valuable habitat (مسکن) for wildlife.
2. **Source of Medicines:** Forests are looked after for medicinal conservation.
3. **Source of Fuel Wood:** The utilization of forest products as fuel wood has played a key role in human societies.
4. **Source of Timber:** Today, developed countries continue to utilize timber (لکڑی) for building houses.
5. **Paper Production:** Wood pulp (گودا) from forests are used for making papers.
6. **Economic Importance:** The forest products industry is a large part of the economy in both developed (ترقی یافتہ) and developing (ترقی پذیر) countries.
7. **Heating and Cooking:** In developing countries, almost 3 billion people rely (انحصار کرتے ہیں) on wood for heating and cooking.
8. **Part of Carbon Cycle:** Forests are also important source of organic carbon, and forests extract carbon dioxide and pollutants (آلودگی کرنے والے) from the air, thus contributing to biosphere stability.
9. **Ornamental Uses:** Forests are also valued for their aesthetic (جمالیاتی) beauty and tourist (سیاح) attraction.

Impacts of deforestation in Pakistan:

- In Pakistan, deforestation is a great threat to biodiversity.
- In the province Khyber Pakhtunkhwa, the closed canopy forests are shrinking (سکڑ رہے ہیں) at approximately 1% per year.

Q.13. What is over-hunting? Also write its effects.

Ans: *Definition:*

The process in which rate of hunting of a species is more than its reproduction rate ;

is called over-hunting.

Effects of over-hunting:

Over-hunting (حد سے زیادہ شکار کرنا) has been a significant cause of the extinction of hundreds of species and the endangerment of many more.

Examples:

Endangered species due to over-hunting are whales, ibex, urial markhor (the national animal of Pakistan) etc.

Commercial hunting, both legal (قانونی) and illegal (غیرقانونی), is the principal threat.

Q.14. Describe some of the programs running in Pakistan for the conservation of biodiversity.

Ans: CONSERVATOIN OF BIODIVERSITY:

The conservation of biodiversity has become a global concern.

Biologists urge the national policy makers to state a set of rules necessary to protect a species. They demand that the laws should define species which are threatened by extinction and must be protected.

Though rich in biodiversity, Pakistan today faces severe (شدید) threats to its animal and plant species. The greatest concern is the loss of natural habitats. Main causes of this loss are rapid growth in human population and the prevailing poverty (غربت) in the rural areas of Pakistan. In addition, low literacy rate (شرح خواندگی) is also a reason for limited success in conservation measures taken so far.

The International Union for the Conservation of Nature and Natural Resources **(IUCN)** and the World Wildlife Fund-Pakistan **(WWF-P)** work in close coordination with Pakistan's Ministry of Environment and other government and non-government institutions. The IUCN has prepared the first national Red List (list of endangered or threatened species).

Following are a few examples of environmental work that has been carried out in Pakistan in order to conserve species and associated habitats.

1. National Conservation Strategy:

In 1980's, the IUCN and the government of Pakistan formulated the National Conservation Strategy for Pakistan for the conservation of Pakistan's biodiversity.

2. UN Convention on Combating Desertification (CCD):

This is an international treaty (معاہدہ) against damage and poverty in drylands (خشک علاقے). Pakistan signed this in 1997.

3. Himalayan Jungle Project (HJP):

Location: It started in 1991 Palas Valley, in Khyber Pakhtunkhwa (KP).

Conservatory Program: It aimed at protecting one of the richest areas of biodiversity in Pakistan.

4. *Conservation of biodiversity of the Suleiman Range, Balochistan:*

Location: Suleiman Range Chilghoza Forest is the largest Chilghoza forest in the world.

Conservatory Program: In 1992 the WWF-P started its conservation program.

5. *Northern Areas Conservation Project:*

Location: The northern areas of Pakistan serve as a habitat for a number of wildlife species. The survival of these species is under threat. The northern areas provide habitats to Musk deer, Snow leopard (برفانی چیتا), Astore markhor and Himalayan ibex, Woolly flying squirrel and the Brown bear.

Conservatory Program: The NACP is a project of WWF-P which is successful in implementing a ban (پابندی) on the hunting of these species.

6. *Conservation of migratory birds in Chitral, KP:*

Location: Chitral lies on the migratory route (ہجرت کرنے کا راستہ) of several important bird species. These birds face enormous hunting pressure.

Conservatory Program: WWF- Pakistan initiated efforts to reduce the hunting pressure in 1992. The efforts proved successful.

7. *Conservation of Chiltan Markhor:*

Location: Hazarganji National Park is located close to Quetta and is the only remaining habitat of Chiltan Markhor in the country. It is estimated that about 200,000 of the one million migratory birds passing through Chitral are killed during migration.

Conservatory Program: WWF-Pakistan developed the management plan of the park.

8. *Ban on games:*

Foreigners (غیر ملکی) visit the northern areas and play many games in which bears (ریچھ) are used.

Conservatory Program: WWF-Pakistan has been successful in imposing a ban on this illegal practice.

Q.15. Describe with examples, some characteristics of endangered species in Pakistan.

Ans: ENDANGERED SPECIES IN PAKISTAN:

Due to many human activities (انسانی سرگرمیاں), the biodiversity in Pakistan is facing a great loss. Here are a few examples of endangered species in Pakistan.

Indus Dolphin:

Number: According to WWF-P, only 600 animals of this species are left today in the Indus River in Pakistan.

Population Affecting Factors: The population of this species declined because of various factors, including water pollution, poaching (غیر قانونی شکار کرنا), and destruction of habitat.

Marco Polo Sheep:

Occurrence: Marco Polo sheep are mostly found in the Khunjerab National Park and nearby areas.

Number: The sheep have an endangered status and their numbers have been rapidly (تیزی سے) decreasing in the last two decades. WWF-P has started projects for its conservation.

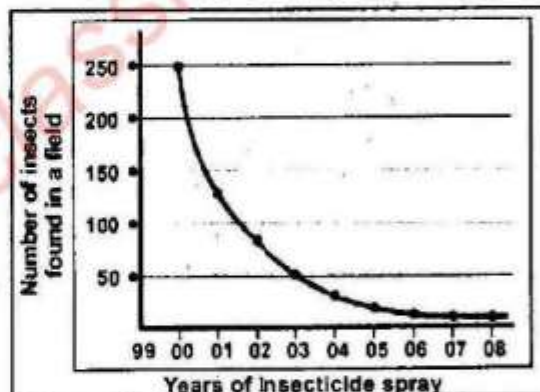
Houbara bustard:

This bird flies to Pakistan in winter season from former Soviet territory and settles in Cholistan and Thar deserts.

Reason of decline population:

The decline (کمی) in its population is due to hunting by foreigners and destruction of its habitats.

Analyzing and Interpreting:

Most insecticides (کیڑے مار ادویات) kill beneficial (کارآمد) insects along with pest species. The following graph shows an example of the effect of an insecticide on an insect population of a field. Hypothesize whether the usage of insecticide may be the factor (وجہ)responsible for the endangered status of this insect.

Graph showing the effect of insecticide on insect population

Did you know?

Markhor is the National animal of Pakistan.

Did you know?

Chakor patridge is the National bird of Pakistan.

Review Questions

MULTIPLE CHOICE:

1. **Classification means the grouping of organisms on the basis of:**
   (a) How they feed (b) The features they have in common
   (c) How they respire (d) How they can survive
2. **The kingdom Protista includes:**
   (a) Unicellular and simple multicellular organisms with prominent nucleus

(b) True multicellular organisms with no prominent nucleus
(c) True multicellular organisms with prominent nucleus
(d) Unicellular organisms with no prominent nucleus.

3. **Viruses are not classified in any kingdom because:**
(a) They are too poorly understood
(b) They are too small
(c) Their genetics cannot be determined
(d) They are not considered organisms

4. **Viruses are assigned to the kingdom:**
(a) Monera (b) Protista (c) Fungi (d) None of the above

5. **A related group of genera comprises:**
(a) An order (b) A family (c) A class (d) A phylum

6. **In which kingdom would you classify unicellular eukaryotes?**
(a) Fungi and plantae (b) Fungi and monera
(c) Only protista (d) Only Fungi

7. **In binomial nomenclature, the first letter of the ______ name is capitalized.**
(a) Family (b) Class (c) Species (d) Genus

8. **Which one of the following sequences shows the correct hierarchy of classification, going from the smaller to the bigger group?**
(a) Kingdom, Phylum, Order, Class, Family, Genus, Species
(b) Kingdom, Phylum, Class, Order, Family, Genus, Species
(c) Genus, Species, Kingdom, Phylum, Order, Class, Family
(d) Species, Genus, Family, Order, Class, Phylum, Kingdom

9. **Which of the following may be the correct way of writing the scientific name of an organism?**
(a) Canis lupis (b) Saccharum (c) Grant's gazelle (d) E. Coli

10. **A certain organism is multicellular, adapted for photosynthesis, and has multicellular sex organs. To which kingdom does it belong?**
(a) Animalia (b) Fungi (c) Plantae (d) Protista

11. **Species that are in the same _________ are more closely related than,**
(a) Phylum....class (b) Family .....order
(c) Class....order (d) Family....genus

12. **When the last member of a particular species dies, the species is said to be _______.**
(a) Established (b) Extinct (c) Threatened (d) Endangered

13. **In which season Houbara bustard migrates to Pakistan and settles here?**

(a) Summer (b) Spring (c) Autumn (d) Winter

Ans: **1.** The features they have in common

2. Unicellular and simple multicellular organisms with prominent nucleus

3. They are not considered organisms **4.** None of the above

5. A family **6.** Only protista **7.** Genus

8. Species, Genus, Family, Order, Class, Phylum, Kingdom

9. Canis lupis **10.** Plantae **11.** Family....genus **12.** Extinct

13. Winter

UNDERSTANDING THE CONCEPTS

1. Relate the importance of biodiversity with natural ecosystem through examples.

Ans: Refer to Q.No.1 for answer.

2. Explain the aims and principles of classification, keeping in view its historical background.

Ans: Refer to Q.No.2 + 3 for answer.

3. Explain the base for establishing five kingdoms of living organisms.

Ans: Refer to Q.No.5 for answer.

4. Justify why virus are excluded from the Five-Kingdom classification system.

Ans: Refer to Q.No.6 for answer.

5. Describe the aims and principles of binomial nomenclature.

Ans: Refer to Q.No.8 for answer.

6. Explain the impact of human beings on biodiversity.

Ans: Refer to Q.No.10 for answer.

7. Identify causes of deforestation and its effects on biodiversity.

Ans: Refer to Q.No.11 for answer.

8. Describe some of the programs running in Pakistan for the conservation of biodiversity.

Ans: Refer to Q.No.13 for answer.

SHORT QUESTIONS

1. What is the difference between the modes of nutrition of fungi and animals?

Ans. The mode of nutrition of fungi is absorptive heterotroph while the mode of nutrition of animal is ingestive heterotroph.

2. *It is difficult to use the criterion of interbreeding to define species of unicellular organisms. Why?*

Ans. Species of unicellular organisms reproduce asexually and do not interbreed with one an other. Therefore it is difficult to use the criterion of inter breeding to define species of unicellular organisms.

3. *How are taxonomy and systematics related?*

Ans. The branch of biology which deals with the classification is called taxonomy and the branch which deals with classification and also traces the evolutionary history of organisms is known as systematics.

4. *Differentiate between the terms "extinct" and "endangered".*

Ans. In an ecosystem, a species is called extinct when there is no doubt that the last individual of the species has died in that ecosystem. A species is called endangered when it is at risk of extinction in near future.

5. *What are the contributions of Whittaker, Margulis and Schwartz in taxonomy?*

Ans. Robert Whittakar introduced the five-kingodm classification system. Margulis and Schwartz modified the five kingdom classification of Whittaker.

THE TERMS TO KNOW

Acellular:

The organism which do not have cellular organization is called acellular.

Animalia:

Animalia is a kingdom. It includes eukaryotic multicellular consumers. Animals lack cell wall and show movements.

Binomial nomenclature:

Binomial nomenclature is the method of giving scientific names to living organisms.

Biodiversity:

Biodiversity is a measure of the variety of organisms present in different ecosystems.

Class:

A class is a group of related orders.

Classification:

Division of living organisms into their groups and subgroups according to their similarities and differences is called classification.

Conservation:

Defining the endangered and threatened species and taking measures for their

protection.

Deforestation:

Deforestation means cutting down of trees for the conversion of a forest to non-forest land.

Endangered species:

A species is called endangered when it is at risk of extinction in near future.

Family:

A family is a group of related genera.

Fauna:

Diversity of animals in any region is called its Fauna.

Flora:

Diversity of plants in any region is called its flora.

Fungi:

Fungi is a kingdom which includes eukaryotic, multicellular heterotrophs which are absorptive in their nutritional mode e.g. mushroom.

Genus:

A genus is a group of related species.

Monera:

Monera is a kingdom which includes prokaryotic organisms monera are autotrophs or heterotrophs.

Order:

An order is a group of related families.

Phylum:

A phylum is a group of related classes.

Plantae:

Plantae is a kingdom of five kingdom system. In this eukaryotic, multicellular and autotrophs organisms are included.

Prion:

Prions are composed of proteins. These cause infectious diseases in certain plants.

Protista:

Protista is a kingdom which includes eukaryotic, unicellular and simple multicellular organisms.

Soil erosion:

Removal of the top layer of fertile soil by flooding and winds is called soil erosion.

Species:

Species is a group of closely related organisms that can interbreed in nature and produce fertile offsprings

Systematics:

The branch which deals with classification and also traces the evolutionary history of organisms is known as systematics.

Taxon:

The groups into which organisms are classified, known as taxonomic categories or texa. The singular of texa is texon.

Taxonomic hierarchy:

The groups into which organisms are classified are known as taxonomic categories or texa. The texa form a ladder, called taxonomic hierarchy.

Viroid:

Viroids are composed of circular RNA only. These are the infectious particles and cause diseases.

INITIATING AND PLANNING

1. Match the binomials of some common local organisms from a two column list on the basis of generic name and specific names.
2. Describe ways in which society benefits from biodiversity.
3. Describe the reasons why a established animal species becomes endangered due to human interference. (e.g. Houbara bustard, Indus dolphin and Marco polo sheep).

ACTIVITIES

1. Observe the distinguishing taxonomic characters from fresh and preserved specimens and recognize plants and animals on the basis of these characters.

SCIENCE, TECHNOLOGY AND SOCIETY

1. Analyze the impact of human beings on biodiversity.
2. Associate advancements in scientific understanding with classification of organisms to develop a more reliable system.
3. Apply the knowledge of classification to assess the characteristics of different organisms when visit to zoos, herbaria, and gardens.
4. Explain the importance of binomial nomenclature in developing a more comprehendible sharing of scientific research.

ON-LINE LEARNING

- http://www.pakistanwetlands.org/
- http://hwf.org.pk
- www.biodiversity.iucnp.org/
- edu.iucnp.org/
- www.wildlifeofpakistan.com/WildlifeBiodiversityofPakistan/
- en.wikipedia.org/wiki/Biodiversity_Action_Plan

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **Allium cepa is the Scientific name of:** (LHR. GI, SGD. GII)
   (A) Onion (B) Potato (C) Tomato (D) Pea
2. **A species that no longer lives in an ecosystem is called:** (LHR. GII)
   (A) Endangered Species (B) Global Ecosystem
   (C) Extinct Species (D) Population
3. **Right sequence of taxa's of taxonomy is ________.** (GRW. GI)
   (A) phylum, family, class, order (B) kingdom, phylum, class, order
   (C) phylum, class, family, order (D) phylum, family, order, genus
4. **A related group of genera comprises ________.** (GRW. GII)
   (A) an order (B) a family (C) a class (D) a phylum
5. **The population of human today lives on Earth is: (millions)** (FBD. GI)
   (A) 200 (B) 400 (C) 600 (D) 800
6. **Eucalyptus plants were imported from:** (FBD. GII, DGK. GI)
   (A) China (B) Australia (C) Africa (D) None of these
7. **The basic unit of classification is:** (MLN. GI)
   (A) Genus (B) Order (C) Species (D) Phylum
8. **The cell wall of Fungi is made up of:** (MLN. GII, RWP. GI & II)
   (A) Chitin (B) Cellulose (C) Chlorophyll (D) None of these
9. **A group of related species is:** (SWL. GI)
   (A) order (B) genus (C) phylum (D) kingdom
10. **Carlous Linnaeus divided nature into kingdoms:** (SWL. GII)
    (A) 2 (B) 3 (C) 4 (D) 5
11. **Five Kingdom classification system was introduced by:** (SGD. GII)
    (A) E-Chatton (B) Robert Whittaker (C) Mar gulis (D) Schwartz
12. **Number of persons increasing in the world population after every one minute is:** (RWP. GI)
    (A) 180 (B) 290 (C) 280 (D) 490
13. **A genus is a group of related:** (RWP. GII)
    (A) Orders (B) Species (C) Classes (D) Families
14. **The Taxon of order was introduced first time:** (DGK. GII)
    (A) Tournefort (B) Linnaeus (C) Rivinus (D) John Ray

15. Which of the following group includes organisms all of which are Prokeryotes? (DGK. GII)

(A) Plants (B) Bacteria (C) Protists (D) Animals

16. The animal unable to reproduce is: (BWP. GI, GRW. GI)

(A) Monkey (B) Horse (C) Donkey (D) Mule

17. The group of nearest Genera is called: (BWP. GII)

(A) Phylum (B) Class (C) Order (D) Family

18. Who introduced the system of classification of organisms for the first time: (LHR. GI)

(A) Ernst Hackel (B) Aristotle
(C) Carlous Linnaeus (D) Robert Whittaker

19. Bacteria are assigned to the kingdom: (LHR. GII)

(A) Fungi (B) Monera (C) Protista (D) Porifera

20. Proposed three kingdom classification: (FBD. GI)

(A) Ernest Hackel (B) E.Chatton (C) King (D) Linnaeus

21. In which kingdom would you classify unicellular eukaryotes? (FBD. GII)

(A) Fungi and plantae (B) Fungi and monura
(C) Only protista (D) Only fungi

22. Common example of Kingdom Fungi is: (MLN. GI)

(A) Mushrooms (B) Fern (C) Algae (D) Mosses

23. Family is a group of related ____________. (MLN. GII)

(A) Genera (B) Orders (C) Classes (D) Species

24. The national bird of Pakistan is: (SWL. GI, BWP. GI)

(A) (chakor) Patridge (B) sparrow (C) pigeon (D) houbara bustard

25. Kingdom protista includes. (SWL. GII)

(A) cyanobacteria (B) bacteria (C) Algae (D) plants

26. Which organism is included in kingdom monera. (SGD. GI)

(A) Cyanobacteria (B) Algae (C) Fungi (D) Virus

27. It deals with the classification of organisms. (SGD. GII)

(A) Taxonomy (B) Entomology (C) Anatomy (D) Botany

28. The order of Human according to classification is: (BWP. GI)

(A) Mammalia (B) Primates (C) Homonidae (D) Pisum

Answers

1.	Onion	2.	Extinct Species	3.	kingdom, phylum, class, order		
4.	a family	5.	600	6.	Australia	7.	Species
8.	Chitin	9.	genus	10.	3	11.	Robert Whittaker
12.	180	13.	Species	14.	Rivinus	15.	Bacteria
16.	Mule	17.	Family	18.	Aristotle	19.	Monera
20.	Ernest Hackel	21.	Only protista	22.	Mushrooms	23.	Genera

24. (chakor) Patridge **25.** Algae **26.** Cyanobacteria **27.** Taxonomy
28. Primates

☆ **Give short answer to the following questions.**

1. What do you know about Biodiversity? (LHR. GI&GII, FBD. GI, MLN. GI, SWL. GI & GII)

Ans: The term "biodiversity" has been derived from 'bio' and 'diversity'.

"The biodiversity of an ecosystem is defined as variety within a species and among species."

Biodiversity is a measure of the variety of organisms present in different ecosystems.

Biodiversity depends on some environmental factors, such as:

- Climate
- Altitude
- Soils
- Presence of other species

Biodiversity is not distributed evenly on Earth. It is the richest in the tropics.

2. Describe two characteristics of kingdom plantae. (GRW. GI)

Ans: Kingdom Plantae:

- Plants make their own food by photosynthesis.
- They have multicellular sex organs.

3. What is the difference between autotrophs and heterotrophs? (GRW. GI & GII, SWL. GI)

Ans: Plants are called autotroph, because they can prepare their own food, while those organism which can not prepare their food are called heterotrophs.

4. In which areas hubara bustard is found? (FBD. GI)

Ans: Hubara bustard flies to Pakistan in winter season from soviet territory and settles in cholistan and Thar deserts.

5. Why we formulate Bionomial Nomenclature? (FBD. GII)

Ans: In Binomial Nomenclature every organism get only a single name which is equally used in all over the world. This system help us to avoid from confusion in which an organism or a plant have different names in different regions, in different languages of the world.

6. Write characteristics of kingdom monera. (FBD. GII)

Ans:
- Kingdom monera contain prokaryotic organisms i.e. they are made of prokaryotic cells.
- Most monerans are heterotrophic but some can perform photosynthesis.
- Bacteria and cyanobacteria are included in this kingdom.

7. Define Binomial Nomenclature. (MLN. GI & GII, GRW. GII, SWL. GI)

Ans: Binomial Nomenclature is the method of giving scientific names to living organisms.

Carlous Linnaeus (1707-1778 AD) introduced a system of giving scientific names

to organisms, this is called binomial nomenclature.

8. How do we write scientific names? Give an example. (MLN. GII)

Ans: 1. Scientific names are usually printed in italics, such as *Homo sapiens*. When handwritten they are underlined.

2. The first term (generic name) always begins with capital letter, while species name is never capitalized (even when derived from a proper name).

3. The scientific name is generally written in full when it is first used. But when several species from the same genus are being listed, it may then be abbreviated by just using an initial for the genus; for example Escherichia coli becomes E.coli.

9. What do you mean by soil erosion? (SWL. GII)

Ans: Removal of the top layer of fertile soil by flooding or winds is called soil erosion.

10. Write the name of any two decomposers. (SGD. GII)

Ans: Bacteria and Fungi are examples of decomposers.

11. What is meant by acellular? (SGD. GII)

Ans: Acellular mean they do not have cellular organization. i.e they are not made up of cell.

12. Differentiate between taxonomy and systematics.
(LHR. GII, RWP. GI, BWP. GII, SGD. GII)

Ans: The branch of biology which deals with the classification is called taxonomy and the branch which deals with classification and also traces the evolutionary history of organisms is known as systematics.

13. What are the bases of five Kingdom system? (RWP. GI, BWP. GI)

Ans: The five-kingdom classification system is based on:

1. The levels of cellular organization i.e. prokaryotic, unicellular eukaryotic and multicellular eukaryotic.
2. The principal modes of nutrition i.e. photosynthesis, absorption, and ingestion.

14. Write down the biological name of human and pea. (RWP. GII, LHR. GII)

Ans: The biological name of human is homo sapiens and pea is pisum sativum.

15. Write a short note on Marco polo sheep. (RWP. GII)

Ans: Marco Polo sheep are mostly found in the Khunjerab National Park and nearby areas. The sheep have an endangered status and their numbers have been rapidly decreasing in the last two decades. WWF-P has started projects for its conservation.

16. Who was Carlous Linnaeus? Why is he famous? (DGK. GI)

Ans: Carolus Linnaeus was a Swedish biologist. He first introduced and adopted the system of binomial nomenclature. His system spread rapidly and became popular.

17. Write down the names of four different kingdoms of organisms. (DGK. GI)

Ans: Organisms are classified in following kingdoms.

1. Monera 2. Protista 3. Fungi 4. Plantae

18. What is the basic unit of Classification? Define it. (BWP. GI)

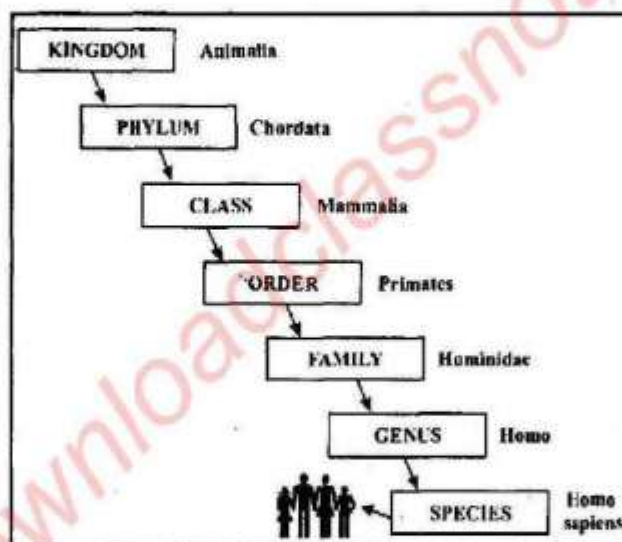
Ans: Species is the basic unit of classification. A species is a group of organisms which can interbreed freely among them and produce fertile offspring, but are reproductively isolated from all other such groups in nature.

19. What is the difference between Extinct and Endangered Species? (BWP. GII)

Ans: Extinct Species: In an ecosystem, a species is called extinct when there is no doubt that the last individual of that species has died in that ecosystem.

Endangered Species: A species is called endangered when it is at risk of extinction in near future.

20. Write down the simple classification of "Human". (D,G.K. GII)

Ans:

21. Write two points on the importance of biodiversity. (LHR. GI)

Ans: Biodiversity is very important in following ways.

1. Biodiversity is a great source of food for livings on land.
2. A significant proportion of drugs is obtained from biological sources directly or indirectly.

22. What is the role of over-hunting in extinction? (LHR. GII)

Ans: Over hunting has been major cause of extinction of species and endangerment of many species such as whales, ibex, urial, markhor etc.

Commercial hunting , both legal and illegal is principal threat to biodiversity.

23. Name three endangered species in Pakistan. (GRW. GI)

Ans: Indus dolphin, Macro polo sheep and houbara bustard are endangered species in Pakistan.

24. What is meant by endangered species? (GRW. GI &G II, BWP. GI, SGD. GI, GRW. GI & GII, FBD.GI)

Ans: A species is called endangered when it is at risk of extinction in near future.

25. What are two important characteristics of kingdom fungi? (FBD. GI, SGD. GI)

Ans: 1. Fungi are absorptive in their nutritional mode.
2. Most fungi are decomposers. They live on organic material, secrete digestive enzymes and absorb foods.

26. Write down any four major causes of species extinction. (FBD. GII)

Ans: Loss of habitat, deforestation, over hunting, introduction or removal of species and pollution are major causes of species extinction.

27. What is meant by deforestation? (FBD. GII)

Ans: The cutting of forests (trees) is called deforestation.

28. Write the scientific names of Onion and House Crow. (MLN. GI)

Ans: Scientific name of Onicn is Allium cepa and House crow is corvus splendens.

29. Define "Taxonomic Hierarchy". (MLN. GII)

Ans: These are the groups in which livings are classified are called taxonomic categories or texa. These texa join to form a ladder called taxonomic hierarchy.

30. Write difference between prions and viroids. (SWL. GI)

Ans: Prions and Viroids are cellular particles, and are not included in five kingdom classification system. The major prions are made up of protein only while viroids are made up of circular RNA only.

31. Write the simple classification of pea from kingdom to order. (SWL. GII)

Ans: Classification of Pea plant

Texa	Pea
Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Pisum
Species	P.sativum

32. Define classification and give its objectives.
(DGK. GII, LHR. GI, SGD. GI & GII, SWL. GI, MLN. GI,)

Ans: The division of living organisms into their groups and sub groups based upon similarities and differences is called classification.

Objectives of classification:

1. To determine similarities and differences among organisms so that they can be studied easily.
2. Evolutionary relationship also find out by classification.

33. Where do you place Viruses status? (RWP. GI)

Ans: Viruses are acellular i.e they do not have cellular organization. Viruses are not considered as organisms and thus are not included in the five-kingdom

classification system. Viruses show some characters of living organisms and also show some characters of non-living organisms. Viruses contain either RNA or DNA, normally encased in protein coat. They reproduce only in living cells, where they cause a number of diseases. Viruses due to their crystalline nature are considered as non-living. They are not considered as organisms and thus are not included in five kingdom classification system.

34. Name the national bird and national animal of Pakistan. (SWL. GI, RWP. GII)

Ans: Chakor (Patridge) is the national bird of Pakistan, while Markhor is national animal of Pakistan.

35. Describe two reasons of deforestation. (RWP. GII)

Ans: 1. Deforestation is done for using land for pasture and urban development.
2. To produce money through fruits, sugar, soap, rubber, paper and different food product deforestation is done.

36. What is five kingdom system? (DGK. GI)

Ans: The classification system in which living organism are classified in five groups is called five kingdom classification system.
This system based upon the cellular organization and mode of nutrition.

37. Write down two characteristics of kingdom protista. (DGK. GII)

Ans: 1. In this kingdom eukaryotic, unicellular and simpler multicultural organisms are included.
2. Animal like protists i.e. protoza are also included. Whose cell lack cell wall and chlorophyll.

38. On which characteristics five Kingdom Classification System is based? (BWP. GI)

Ans: Five kingdom system classification based upon cellular organization, mode of nutrition and genetics.

39. What type of organisms are included in Kingdom Monera? Give example. (BWP. GI)

Ans: In kingdom monera prokaryotic organism (made up of prokaryotic cells), are kept. e.g. Bacteria and cyano bacteria.

40. What is meant by biodiversity? (BWP. GII)

Ans: The term biodiversity has been derived from bio and diversity. The variety with in a species and among species is called biodiversity.

41. Define Taxonomy. (BWP. GII)

Ans: The branch of biology which deals with naming and classification of organisms into groups and sub groups is called taxonomy.

CELLS AND TISSUES

Major Concepts:

4.1 MICROSCOPY AND THE EMERGENCE OF CELL THEORY

Q.1. Define the term microscopy (خوردبینی). What do you know about the terms magnification and resolution?

Ans: MICROSCOPY:

Microscopy is the use of microscope to observe minute (بالکل چھوٹی) living organisms.

Invention of microscope: The first compound microscope was developed by Zacharias Janssen, in Holland in 1595. It was simply a tube with lenses at each end and its magnification (بڑھاؤ) ranged from 3x to 9x.

Types of Microscopes: In microscopy, two types of microscopes are used.

1. Light microscope (LM) 2. Electron microscope (EM)

Important Terms of Microscopy:

Two important terms (اصطلاحات) are used in microscopy.

1. Magnification:

Magnification is the increase in the apparent (ظاہری) size of an object and it is an important factor in microscopy.

2. Resolution or resolving power:

Resolution or resolving power is the minimum (کم سے کم) distance at which two objects can be seen as separate objects. It is the measure of the clarity (واضح) of an image.

Resolution of Human Eye:

The human naked eye can differentiate between two points, which are at least 0.1 mm apart (فاصلے پر). This is known as the resolution of human eye.

Human eye would not be able to differentiate two objects as two separate objects, if they are placed 0.05mm apart. The resolution of eye can be increased with the help of lenses.

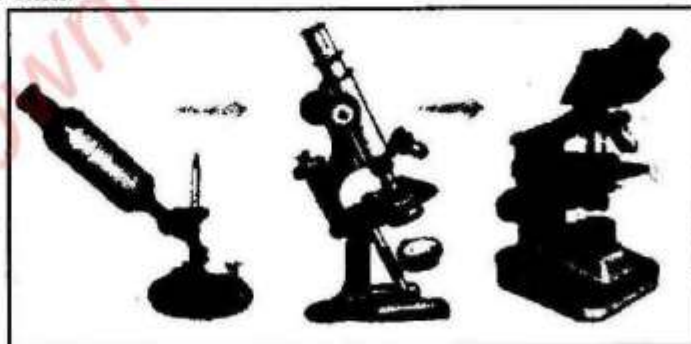
4.1.1 LIGHT MICROSCOPY AND ELECTRON MICROSCOPY

Q.2. Describe the structure and function of light microscope.

Ans: LIGHT MICROSCOPE:

Light microscope works by passing visible (نظر آنے والی) light through a specimen.

Construction (بناوٹ):

It uses two glass lenses. One lens produces an enlarged (بڑا کیا ہوا) image of the specimen and the second lens magnifies the image and projects it into the viewer's eye or onto photographic film.

Light microscopes: From earlier (left) to the latest (right)

Micrograph:

A photograph taken through a microscope is called micrograph.

Magnification of LM:

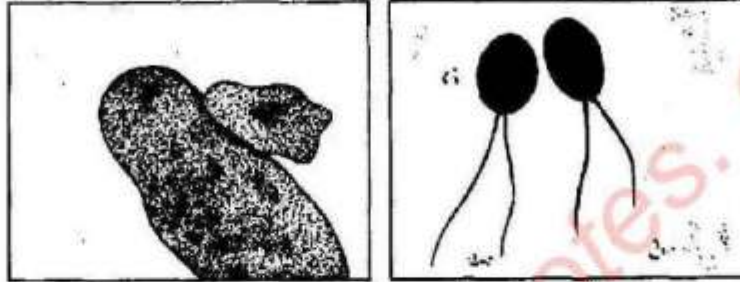
A light microscope can magnify objects only about 1500 times without causing blurriness (دھندلاہٹ) i.e. its magnification is **1500X**.

Resolving power of LM:

Its resolving power is 0.2 micrometer (μm) and 1 μm = 1/1000 mm. In other

words, the LM cannot resolve (distinguish) objects smaller than 0.2 µm. It is about the size of the smallest bacterium.

Limitation of LM:

The image of unicellular or bacterium can be magnified many times, but the light microscope cannot show the details (تفصیل) of its internal structure.

Light microscopic view; amoebae (left), unicellular algae (right)

When we see a microscope on the page of a book, we see some words like "LM 109X" printed along the edge (کنارہ) of the micrograph. It tells us that the photomicrograph was taken through a light microscope and that the image has been magnified 109 times (گنا).

Q.3. Describe the structure and function of electron microscope.

Ans: ELECTRON MICROSCOPE:

It is the most advanced (بہترین) form of microscope.

Construction:

In EM, the object and the lens are placed in a vacuum (خلا) chamber and a beam of electrons is passed through object.

Working:

Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or photographic film.

Resolving power of EM:

The EM has much higher resolving power than LM. The most modern EM can distinguish objects as small as 0.2 nanometer (nm) and 1 nm = 1/100,000 mm. It is a thousand-fold (ہزار گنا) improvement over the LM.

Electron Microscope

Magnification power of EM:

EM can magnify objects about 250,000 times. Under Special conditions EM can detect individual atoms.

Limitations (محدود) of EM:

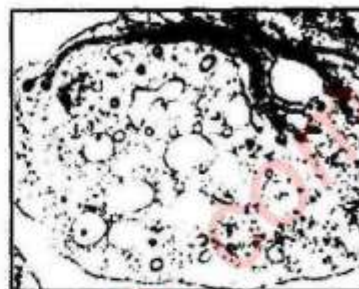
EM cannot be used to study life processes because the specimen must be held in a

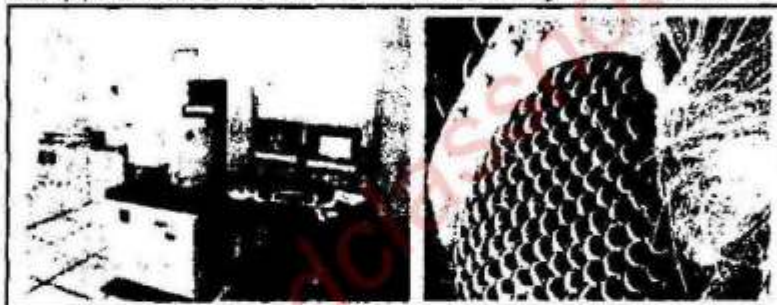
vaccum chamber. To study the life processes a light microscope is better.

Types of electron microscope:

Biologists use two types of electron microscope.

1. Transmission Electron Microscope (TEM)
2. Scanning Electron Microscope (SEM)

1. Transmission Electron Microscope (TEM):
TEM is used to study the details of the internal cell structure. In TEM, electrons are transmitted through the specimen.

The TEM view of an animal cell

2. Scanning Electron Microscope (SEM): In SEM, electrons are reflected from the metal-coated (دھاتی تہہ چڑھی ہوئی) surfaces. SEM is used to study the structure of cell surfaces.

The SEM view of mosquito's head and eye

4.1.2 HISTORY OF THE FORMULATION OF CELL THOERY

Q.4. Write down the history of the formulation of cell theory.

Ans: In the history of the biological sciences, ancient Greeks were the first who organized the data of the natural world.

Contribution of Aristotle:

Aristotle presented the idea that all animals and plants are somehow (کسی نہ کسی طرح) related. Later this idea gave rise to questions like "is there a fundamental unit of structure shared by all organisms?" But before microscopes were first used in 17th century, no one knew with certainty (یقینی طور پر) that living organisms do share a fundamental unit i.e. cell.

Contribution of Robert Hooke:

Cells were first described by a British scientist, **Robert Hooke** in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a "honeycomb (شہد کا چھتہ)" of tiny empty compartments. He called the compartments in the cork as "cellulae". His term has come to us as cells.

Contribution of Leeuwenhoek:

The first living cells were observed a few years later by the Dutch naturalist Antonie van Leeuwenhoek. He observed tiny organisms (from pond (جوہڑ) water) under his

microscope and called them as "animalcules".

Contribution of Robert Hooke:

Robert Hooke was a chemist, mathematician (ریاضی دان) and physicist. His remarkable engineering abilities enabled him to invent and improve many mechanical devices, including timepieces, the quadrant, and the Gregorian telescope. His observation about the section of cork is also illustrated here.

Robert Hooke and his microscopic observation

Contribution of Jean Baptist de-Lamarck:

In 1809, **Jean Baptist de-Lamarck** proposed (تجویز کیا) that "nobody can have life if its parts are not cellular tissues or are not formed by cellular tissues".

Contribution of Robert Brown:

In 1831, a British botanist **Robert Brown** discovered (دریافت کیا) nucleus in the cell.

Contribution of Matthias Schleiden:

In 1838, a German botanist **Matthias Schleiden** studied plant tissues and made the first statement of the cell theory. He stated that all plants "are aggregates (مختلف اجزا کا مجموعہ) of individual cells which are fully independent."

Contribution of Theodor Schwann:

In 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells. Thus Schleiden and Schwann proposed cell theory in its initial form.

Contribution of Rudolf Virchow:

In 1855 Rudolf Virchow, a German physician, proposed an important extension (توسیع) of cell theory. He proposed that all living cells arise from pre-existing cells ("Omnis cellula e cellula").

Rudolph Virchow, Matthias Schleiden and Schwann
Three great German biologist

Contribution of Louis Pasteur:

In 1862, Louis Pasteur provided the experimental proof (تجرباتی ثبوت) of this idea.

Importance of cell theory:

1. The cell theory is regarded as one of the most fundamental (بنیادی) knowledge in biology.
2. It has wide ranging effects in all fields of research (تحقیق).
3. After the initial (ابتدائی) presentation of the cell theory by Schleiden and Schwann, many details of cells were studied and cell theory was extended.

Q.5. What are the principles (اصول) of cell theory? What do you understand by the term sub-cellular or Acellular particles?

Ans: The cell theory, in its modern form, includes the following principles;

1. All organisms are composed of one or more cells.
2. Cells are the smallest living things, the basic unit of organization of all organisms.
3. Cells arise only by divisions in previously existing cells.

Sub-cellular or Acellular Particles:

According to the first principle of the cell theory all organisms are composed of one or more cells.

- Virus, prions and viroids are not composed of cells; rather they are sub-cellular or acellular particles.
- They do not run any metabolism inside them.
- They show some characteristics (خاصیتیں) of living organisms i.e. they can increase in number and can transmit (منتقل کر سکتے ہیں) their characteristics to the next generations (نسلیں).

4.2 CELLULAR STRUCTURES AND FUCNTIONS

Q.6. What is cell? Write its types. Draw and label the diagrams of plant and animal cells.

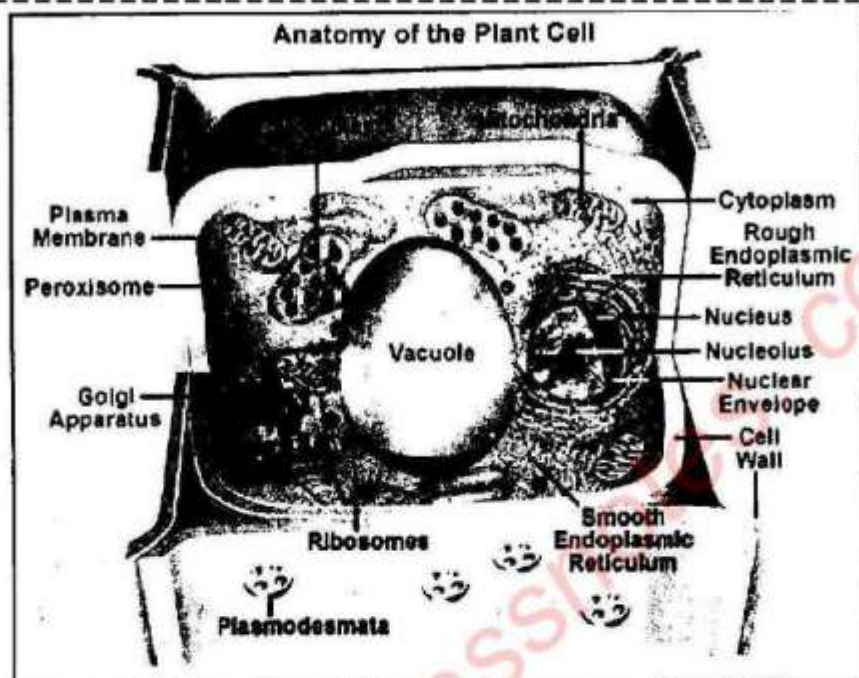
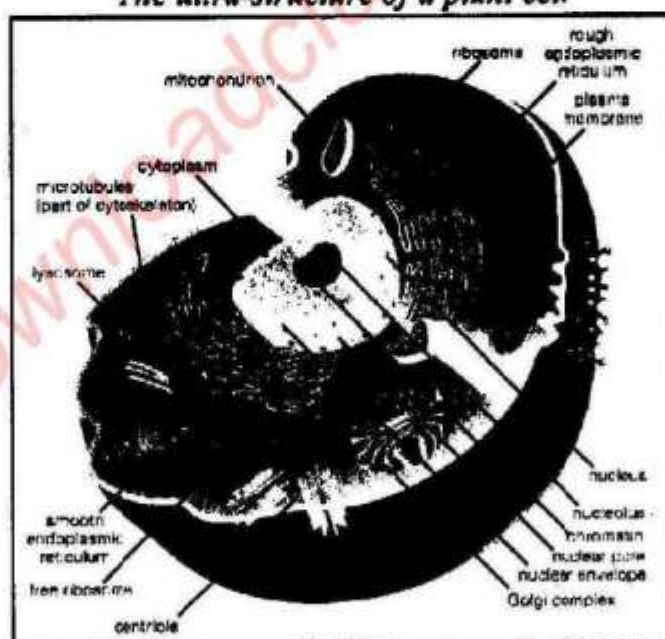
Ans: Cell:

A cell is the basic structural and functional unit (اکائی) of life.

A cell is made by the assemblage of organelles.

There are two general types of cells.

1. Prokaryotic cells **2.** Eukaryotic cells

There are some structures in cell that are not organelles, but are still very important for cell. They are cell wall, cell membrane, cytoplasm, and the cytoskeleton.

The ultra-structure of a plant cell

The ultra-structure of an animal cell

4.2.1 CELL WALL

Q.7. What is cell wall? Describe its structure, functions and composition.

Ans: CELL WALL:

The cell wall is a non-living and strong component of the cell, located outside the

plasma membrane.

Functions:

It provides shape, strength, protection (حفاظت) and support to the inner living matter of the cell.

Chemical composition:

Plant cells have a variety of chemicals in their cell walls.

Primary wall (ابتدائی دیوار):

The outer layer (تہہ) of the plant cell wall is known as primary wall and cellulose is the most common chemical in it.

Secondary wall (ثانوی دیوار):

Some plant cells, such as xylem cells, also have secondary walls on the inner side of the primary wall. It is much thicker (بہت موٹی) and contains lignin and other chemicals.

Plasmodesmata:

There are pores (مسام) in the cell walls of adjacent (ملحق) cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

Cell wall of Fungi: Cell wall of fungi are made of chitin.

Cell wall of Prokaryotes:

Prokaryotes have a cell wall composed of peptidoglycan that is a mixture of amino acids and sugar.

4.2.2. CELL MEMBRANE

Q.8. Explain the structure, composition and functions of cell membrane.

Ans: CELL MEMBRANE:

Cell membrane is present in all prokaryotic and eukaryotic cells.

Location:

It is a thin and elastic membrane covering the cytoplasm.

FUNCTIONS

1. ***Maintains (قائم رکھتا ہے) cell's internal composition:***

   The cell membrane functions as a semi-permeable (چھانے اور نہ چھانے والی جھلی) barrier, allowing a very few molecules across it while fencing the majority of chemicals inside the cell. In this way, the cell membrane maintains the internal composition of the cell.

2. ***Cell recognition:***

   Cell membrane can identify (پہچان سکتا ہے) other cells etc.

3. ***Acts as a receptor:***

   Cell membrane can sense (محسوس کرسکتا ہے) chemical messages.

4. ***Protection many organelles:***

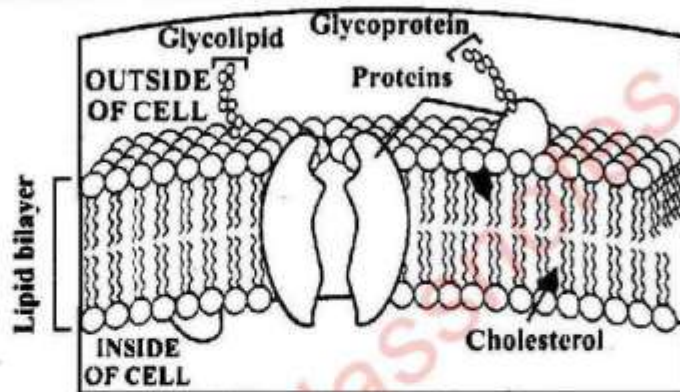
   In eukaryotic cell many organelles e.g. mitochondria, chloroplasts, Golgi apparatus,

and endoplasmic reticulum are also bounded (بند ہوتے ہیں) by cell membranes.

Chemical Composition:

Cell membrane is mainly composed of proteins and lipids with small quantities (مقداریں) of carbohydrates.

Fluid-Mosaic Model:

Electron microscopic examinations of cell membranes have led to the development of the fluid-mosaic model of cell membrane.

The fluid-mosaic model of cell membrane

According to this model:

- There is a lipid bilayer in which protein molecules are embedded.
- The lipid bilayer gives fluidity (بہنے کی خاصیت) and elasticity (لچک) to membrane.
- Small amounts of carbohydrates are also found in cell membranes. These are joined with proteins and lipids of the membrane.
- In eukaryotic cells, cholesterol is also present in lipid bilayer.

4.2.3 CYTOPLASM

Q.9. What is cytoplasm? Write its composition and functions.

Ans: CYTOPLASM:

Definition:

Any material present between the plasma membrane (cell membrane) and the nuclear envelope is called *cytoplasm*.

Chemical Composition:

Cytoplasm is a semi-viscous (نیم سیال) and semi-transparent (نیم شفاف) substance. It contains water in which many organic molecules (proteins, carbohydrates, lipids) and inorganic salts are completely or partially (جزوی) dissolved (حل ہو جاتے ہیں).

Functions:

(i) The cytoplasm of the cell provides space for the proper functioning of the organelles.
(ii) It acts as the site for various metabolic reactions (ردِعمل), for example, Glycolysis.

4.2.4 CYTOSKELETON

Q.10. Write a note on cytoskeleton.

Ans: CYTOSKELETON:

The cytoskeleton is a network (مربوط سلسلہ) of microfilaments and microtubules.

Types of Filaments:

Most important types of filaments (باریک ریشے) that make up the cytoskeleton are:

1. Microtubules **2.** Microfilaments

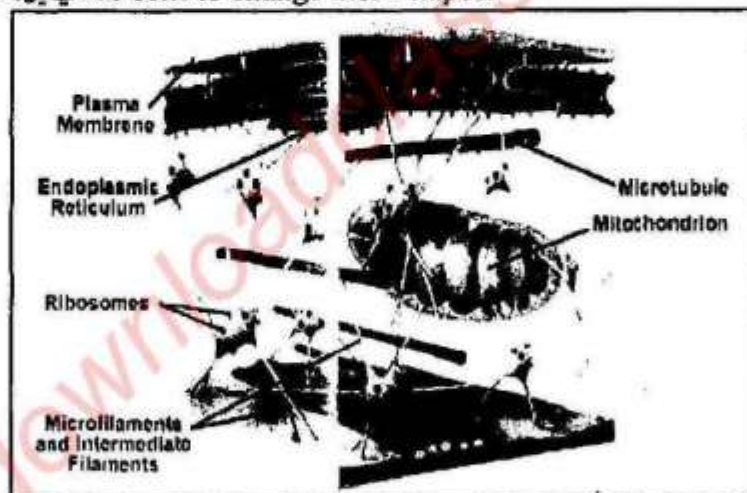
1. ***Microtubules:***

(a) Microtubules are made of tubulin protein and are used by cells to hold their shape.

(b) Microtubules are the major component (جزو) of cilia and flagella.

2. ***Microfilaments:***

(a) Microfilaments are made of actin protein.

(b) They help (مدد دیتے ہیں) cells to change their shapes.

Cytoskeleton

4.2.5 CELL ORGANELLES

Q.11. Define cell organelles.

Ans: Organelles are small structures within cells that perform their specific (مخصوص) functions. There are many types of organelles commonly found in eukaryotic cells.

Examples: Mitochondria, Golgi bodies, Vacuoles, Endoplasmic reticulum, etc. Ribosomes are only organelles which are present in both eukaryotic and prokaryotic cells.

Q.12. What is nucleus? Write its composition, structure and function.

Ans: NUCLEUS:

A prominent (نمایاں) nucleus occurs in eukaryotic cells.

Location:

In animal cells it is present in the center while in mature (بالغ) plant cells, due to the formation of large central vacuole, it is pushed to side.

Nuclear Envelope:

The nucleus is bounded by a double membrane known as nuclear envelope (غلاف). The nuclear envelope contains many small pores that enable it to act as a semi-permeable membrane.

Nucleoplasm:

Inside the nuclear envelope a granular (دانے دار) fluid, the nucleoplasm, is present.

Nucleoli:

The nucleoplasm contains one or two nucleoli (singular; nucleolus) and chromosomes. The nucleolus is a dark spot (دھبہ) and it is the site (جگہ) where ribosomal RNA are formed and assembled as ribosomes.

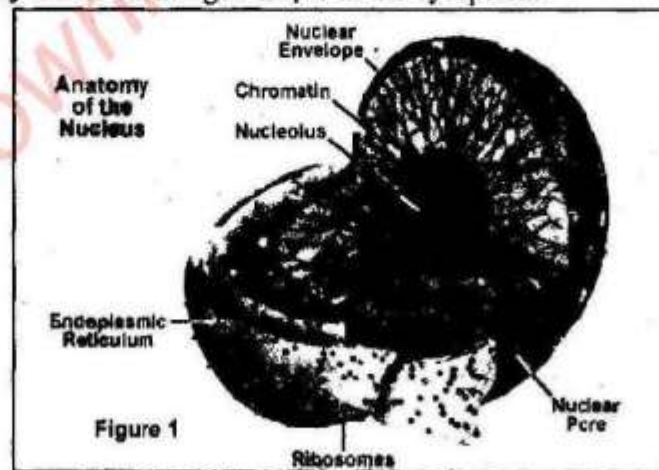
Chromosomes:

Chromosomes are visible (نظر آتے ہیں) only during cell division while during interphase (non-dividing phase) of the cell they are in the form of fine thread-like (باریک دھاگے نما) structures known as chromatin.

DNA:

Chromosomes are composed of Deoxyribonucleic acid (DNA) and proteins.

Nucleus in Prokaryotic cells:

The prokaryotic cells do not contain prominent nucleus rather their chromosome is made of DNA only and is submerged (ڈوبا ہوا) in the cytoplasm.

Structure of Nucleus

Q.13. Describe the structure and functions of:

1. Ribosomes 2. Mitochondria 3. Plastids

Ans: 1. Ribosomes:

Ribosomes are tiny (بہت چھوٹے) granular structures.

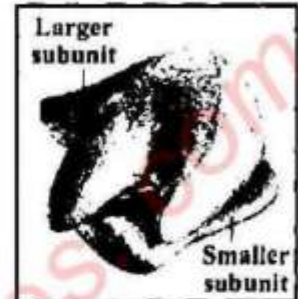
Location:

Ribosomes are either floating (تیرتے ہوئے) freely (آزادانہ) in cytoplasm or are bound to endoplasmic reticulum (ER).

Eukaryotic Ribosomes:

Eukaryotic ribosomes are slightly larger (تھوڑے بڑے) than prokaryotic ones.

Structure:

Each ribosome is made up of almost (تقریباً) equal amounts of proteins and ribosomal RNA (rRNA). Ribosomes are not bound by membranes and so are also found in prokaryotes.

Ribosomes

Functions:

Ribosomes are the sites of proteins synthesis.

Protein synthesis is extremely (بہت زیادہ) important to cells, and so large numbers of ribosomes are found throughout cells.

Smaller units of Ribosomes:

Ribosomes disassemble into two smaller units when it is not working.

Ribosomes in Prokaryotes:

Ribosomes are not bound by membranes and so are also found in Prokaryotes.

2. Mitochondria:

Structure:

Mitochondria (singular: mitochondrion) are the double membrane (جھلی) -bounded structures found only in eukaryotes.

Outer membrane:

The outer membrane of a mitochondrion is smooth (ہموار).

Mitochondrion

Inner membrane:

The inner membrane forms many infoldings (بہت سی تہیں), called cristae in the inner mitochondrial matrix.

Function of Cristae:

The cristae increase the surface area (سطحی علاقہ) of inner membrane on which membrane-bound reactions can take place.

Functions:

These are the sites of aerobic respiration (تنفس), and are the major energy production centers.

Presence of DNA and Ribosomes:

Mitochondria have their own DNA and ribosomes; these ribosomes are more similar (مشابہ) to bacterial ribosomes than to eukaryotic ribosomes.

3. Plastids:

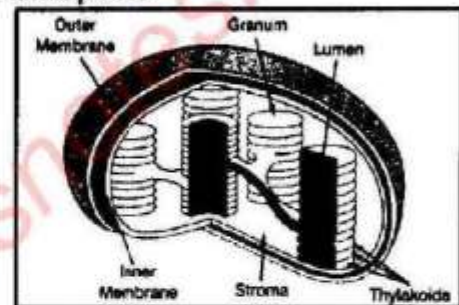
Plastids are membrane-bound organelles that only occur in plants and photosynthetic protists (algae).

Types of Plastids:

There are three types of plastids:

1. Chloroplasts 2. Chromoplasts 3. Leucoplasts

1. Chloroplasts:

Chloroplast is bound by a double membrane. The outer membrane (بیرونی جھلی) is smooth while the inner membrane gives rise to sacs (تھیلی نما) called **thylakoids**. The stack of thylakoids is known as granum [plural = grana] floating in a fluid termed the stroma.

Structure of the chloroplast

Functions:

Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll, the green pigment (رنگ دار مادہ) necessary for photosynthesis, and associated pigments. These pigments are present in thylakoids of the grana.

2. Chromoplasts:

They contain pigments associated with the bright (چمکدار) colors and are present in the cells of flower petals (پتیاں) and fruits.

Function:

Their function is to give colors to these parts and thus help in pollination and dispersal (بکھراؤ) of fruit.

3. Leucoplasts:

Leucoplasts are colourless (بے رنگ) plastids and store starch (نشاستہ), proteins and lipids (چکنائی). They are present in the cells of those parts where food is stored.

Q.14. Describe the structure and function of endoplasmic reticulum and Golgi apparatus.

Ans: ENDOPLASMIC RETICULUM (ER):

Endoplasmic reticulum is a network of interconnected (باہم پیوست) channels that extends from cell membrane to the nuclear envelope.

Forms of ER:

This network exists in two forms:

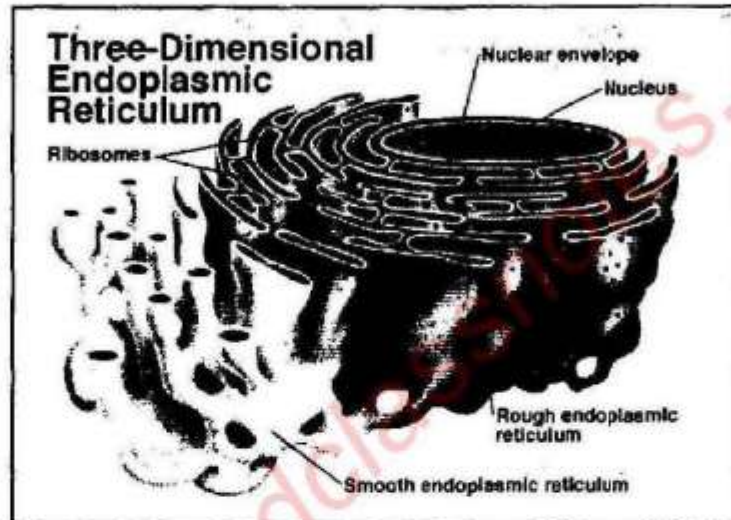
1. Rough Endoplasmic Reticulum (RER)

2. Smooth Endoplasmic Reticulum (SER)

1. Rough Endoplasmic Reticulum (RER):

Rough endoplasmic reticulum is so-named because of its rough (کھردری) appearance due to the numerous (لاتعداد) ribosomes (لحمیات پر مشتمل مہین ذرے) that are attached to it.

Function:

Due to the presence of ribosomes, RER serves a function in protein synthesis.

Smooth and Rough Endoplasmic Reticulum

2. Smooth Endoplasmic Reticulum (SER):

Smooth endoplasmic reticulum lacks (کمی ہوتی ہے) ribosomes.

Functions:

1. It is involved in lipid metabolism and in the transport (منتقلی) of materials from one part of the cell to the other.
2. It also detoxifies (زہریلا پن دور کرتا ہے) the harmful chemicals that have entered cell.

Golgi Apparatus:

An Italian physician named **Camillo Golgi** discovered a set of flattened (ہموار) sacs **(cisternae)** that are stacked over each other.

Golgi apparatus:

Golgi named this set of cisternae as Golgi apparatus also called Golgi complex.

Presence of Golgi apparatus:

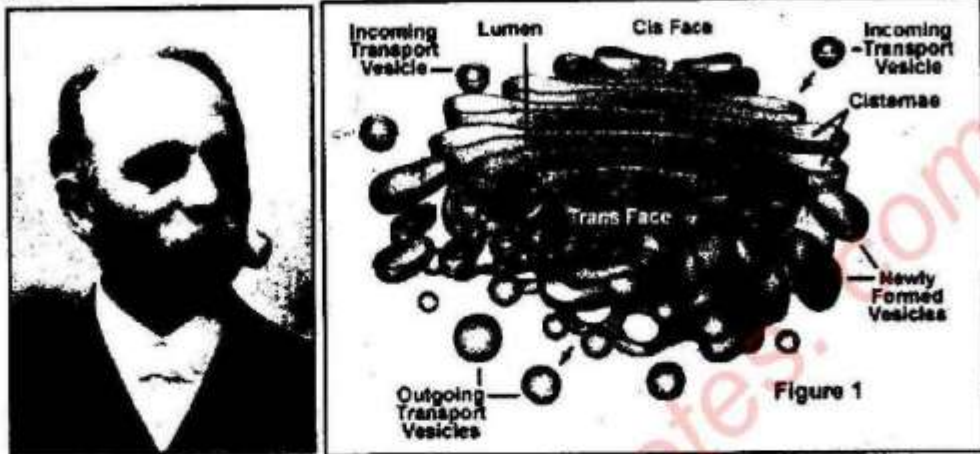
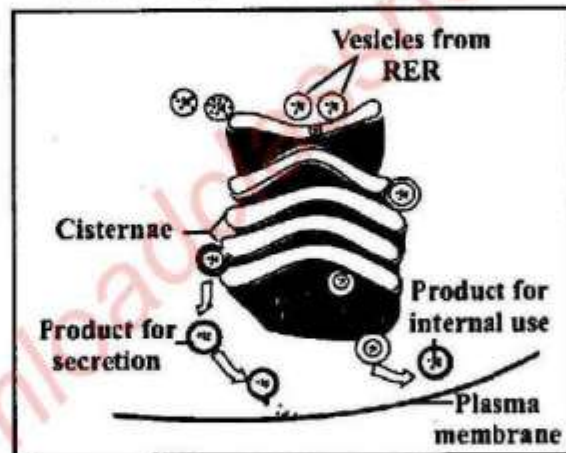
It is found in both plant and animal cells.

Formation of Golgi vesicles:

Golgi apparatus modifies (تبدیل کرتا ہے) molecules coming from rough ER and packs them into small membrane bound sacs called **Golgi vesicles**.

Transport of Golgi vescles:

These sacs can be transported to various locations (مختلف سمتوں میں) in cell or to its

exterior, in the form of secretions.

Camillo Golgi and the Golgi apparatus

Functioning of the Golgi apparatus

Q.15. What are lysosomes? Who discovered it? Describe the formation and function of lysosomes.

Ans: LYSOSOMES:

A Belgian scientist **Christian Rene de Duve** discovered lysosomes in the mid-twentieth century (بیسویں صدی کے وسط میں). De Duve won the Nobel Prize 1974 for physiology and medicine.

Figure: De Duve

Structure:

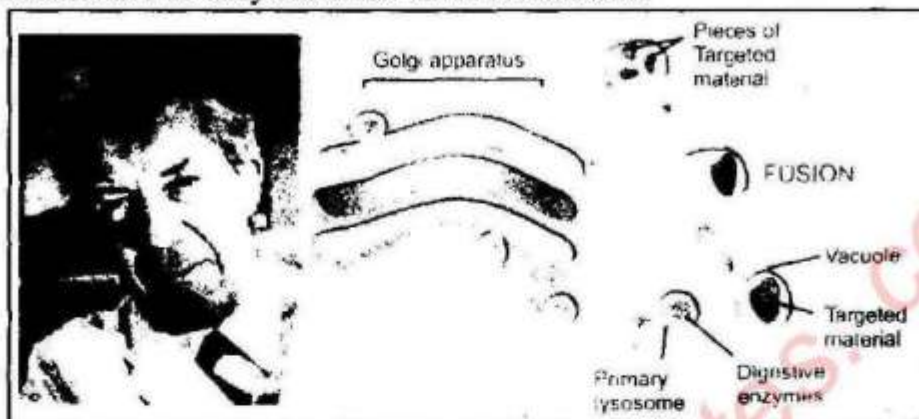
These are single-membrane bound organelles.

Presence of digestive enzyme:

Lysosomes contain strong digestive enzymes and work for the breakdown (توڑ پھوڑ) (digestion) of food and waste materials with in the cell.

Function:

During its function, a lysosome fuses (ملتا ہے) with the vacuole that contains the

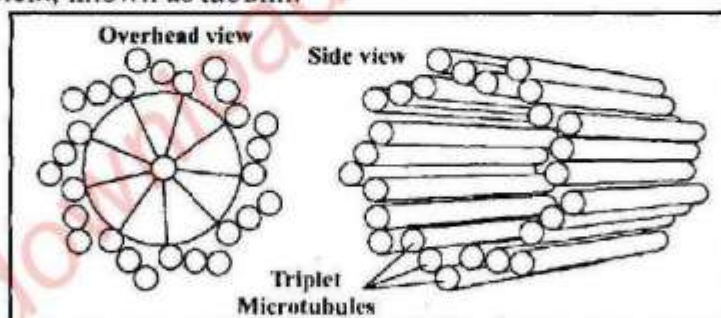
targeted material and its enzymes break down the material.

The formation and function of lysosomes

Q.16. Describe the structure and function of centrioles and vacuoles.

Ans: CENTRIOLES:

Animals and many unicellular organisms have hollow (کھوکھلی) and cylindrical organelles known as centrioles.

Structure:

Each centriole is made of nine triplets (تین کے گچھے) of microtubules that are composed of an important protein, known as tubulin.

Structure of centrioles

Centrosome:

Animal cells have two centrioles located near the exterior surface (بیرونی سطح) of the nucleus. The two centrioles are collectively (مجموعی طور پر) called a centrosome.

Function:

Their function is to help in the formation of spindle fibers during cell division.

In some cells, centrioles are involved in the formation of cilia and flagella.

VACUOLES:

Vacuoles are fluid filled single-membrane bound organelles.

Cells have many small vacuoles in their cytoplasm.

Vacuole in plant cells:

When a plant cell matures its small vacuoles absorb (جذب کرتا ہے) water and fuse to

form a single large vacuole in the center. The cell in this state becomes turgid (پھولا ہوا).

Food vacuole:

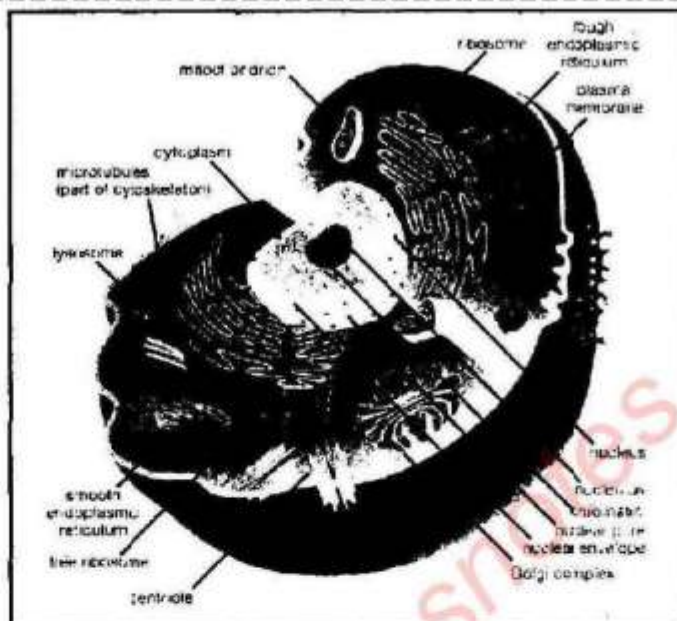
Many cells take in materials from outside in the form of food (خوراک کی شکل میں) vacuole and then digest the material with the help of lysosomes.

Contractile vacuole:

Some unicellular organisms use contractile vacuole for the elimination (ختم کرنا) of wastes (فاسد مادے) from their bodies.

Q.17. Compare animal and plant cells.

Ans: ***Comparison (موازنہ) of animal and plant cell.***

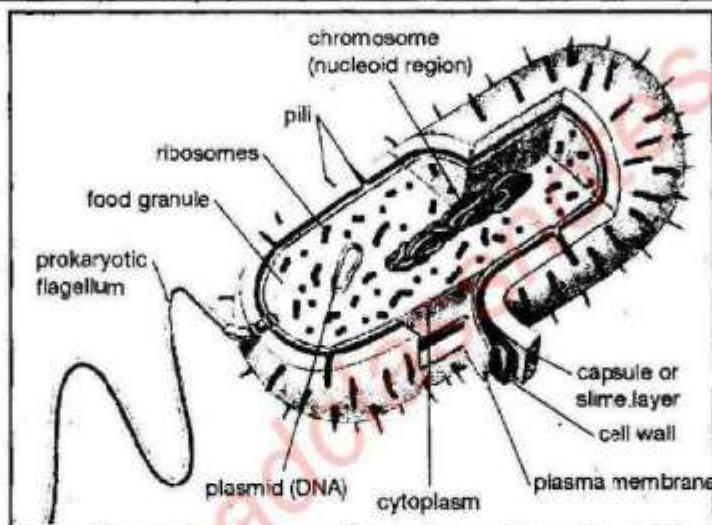
	Animal Cell	Plant Cell
Shape:	Round (irregular shape)	Rectangular (fixed shape)
Cilia:	Present	It is very rare (بہت کم)
Nucleus:	Present	Present
Mitochondria:	Present	Present
Cytoplasm:	Present	Present
Chloroplast:	Animal cells don't have chloroplasts	Plant cells have chloroplasts because they make their own food
Golgi Apparatus:	Present	Present
Cell wall:	Absent	Present
Plasma Membrane:	Present	Present
Microtubules/ Microfilaments:	Present	Present
Lysosomes:	Lysosomes occur in cytoplasm.	Lysosomes usually not evident (ظاہر نہیں ہوتے).
Flagella:	May be found in some cells	May be found in some cells
Ribosomes:	Present	Present
Endoplasmic Reticulum (Smooth and Rough):	Present	Present
Plastids:	Absent	Present
Vacuole:	One or more small vacuoles (much smaller than plant cells).	One, large central vacuole taking up 90% of cell volume.
Centrioles:	Present in all animal cells	Not present in all plants.

The ultra-structure of an animal cell

4.2.6 DIFFERENCE BETWEEN PROKARYOTIC AND EUKARYOTIC CELLS

Q.18. Discuss differences between prokaryotic cells and eukaryotic cells.

Ans: DIFFERENCE BETWEEN PROKARYOTIC AND EUKARYOTIC CELLS:

	Eukaryotic Cell	*Prokaryotic Cell*
Size:	Ten times larger than prokaryotic cells	Very minute (بہت چھوٹا) in size.
Ribosomes:	Ribosmoes in Eukaryotic cells are larger in size	Ribosomes in prokaryotic cell are smaller.
Endoplasmic Reticulum:	Present	Absent (موجود نہیں ہوتا)
Capsule:	Absent	Present in some
Cell wall:	The cell wall of eukaryotic cell is made of cellulose (in plants) or chitin (in fungi). It is absent in animal cells.	Prokaryotes have a cell wall composed of peptidoglycan that is a single large polymer of amino acids and sugars.
Centrioles:	Yes (all animals and some lower plant forms)	Centrioles are absent
Golgi Complex:	Present	Present
Lysosomes:	Common in animals; Not present in plants	Absent

Nucleus:	Prominent nucleus is present	Nucleus is not very prominent
Chromosomes:	Several (بہت سے) chromosomes	Their chromosome consists of DNA only and it floats (تیرتا ہے) in cytoplasm near centre.
DNA:	The DNA of eukaryotes is much more complex (پیچیدہ) and extensive (پھیلا ہوا).	It is simpler in prokaryotes.

Structure of a generalized prokaryotic cell

4.2.7 RELATIONSHIP BETWEEN CELL FUNCTION AND CELL STRUCTURE

Q.19. State the relationship between cell function and cell structure.

Ans: Different cell types make the bodies of animals and plants. Each type performs specific (مخصوص) function and all coordinated (مربوط) functions become the life processes of the organism.

Difference in cells:

Differences in the types of cells could be due to:

1. ***Size and shape:***

i. Nerve cells are long for the transmission (پہنچانا) of nerve impulse (عصبی تحریک).

ii. Xylem cells are tube-like and have thick walls for conduction of water and support.

iii. Red blood cells are round to accommodate globular haemoglobin.

2. ***Surface area to volume ratio (نسبت):***

Root hair cells have large surface area for the maximum absorption of water and salts.

3. ***Presence or absence (موجودگی یا عدم موجودگی) of organelles:***

i. Cells involved in making secretions have more complex ER and Golgi apparatus.

ii. Cells involved in photosynthesis have chloroplasts.

CELL SPECIALIZATION:

Cells are specialized to perform their specific functions, for example in human body.

- ***Function of nerve cells:***
  Conduction of nerve (اعصابی) impulse takes place through nerve cells and thus contributes in coordination within the body.
- ***Function of muscle cells:***
  Muscle cells contract (سکڑتے ہیں) and show movements (حرکات) in body.
- ***Function of red blood cells:***
  Red blood cells carry oxygen and contribute in the role of blood in transportation of gases.
- ***Function of white blood cells:***
  White blood cells kill foreign agents (بیرونی عوامل) and so contribute in the role of blood in defence (دفاع).
- ***Function of skin cells:***
  (i) Some skin cells act as physical barriers against foreign materials.
  (ii) Some skin cells act as receptors (اثر قبول کرنے والے) for temperature, touch, pain etc.
- ***Function of bone cells:***
  The cells of bone deposit (جمع کرتے ہیں) calcium in their extracellular spaces to make the bone tough (سخت) and thus contribute to the supporting role (سہارا دینے والا کردار) of bones.
- ***Cell works as an open system:***
  (i) A cell works as an open system i.e. it takes in substances needed for its metabolic activities through its cell membrane.
  (ii) It performs the metabolic processes assigned to it. Products and by-products are formed in metabolism.
  (iii) Cell either utilizes the products or transports them to other cells.
  (iv) The by-products are either stored or are excreted (خارج کی جاتی ہیں) out of the cell.

4.3 CELL SIZE AND SURFACE AREA TO VOLUME RATIO

Q.20. Explain how surface area to volume ratio limits cell size?

Ans: Cells vary (مختلف ہوتے ہیں) greatly in size.

Mycoplasmas:

The smallest cells are bacteria called mycoplasmas, with diameter between 0.1 μm to 1.0 μm.

Different types of cell:

The bulkiest (بھاری) cells are bird eggs, and the longest cells are some muscle cells and nerve cells. Most cells lie between these extremes (آخری حدوں کے درمیان).

Cell size and shape:

Cell size and shape are related to cell function.

(i) Bird eggs are bulky because they contain a large amount of nutrient (توانائی بخش غذا) for the developing young.

(ii) Long muscle cells are efficient in pulling different body parts together.

(iii) Lengthy (لمبے) nerve cells can transmit nerve signals (پیغامات) between distant (دور) parts of animal's body.

(iv) On the other hand, small cell size also has many benefits.

Example:

Human red blood cells are only 8 m in diameter and therefore can move through our tiniest blood vessels, i.e. capillaries.

Most cells are small in size in relation to their volume. Large cells have less surface area in relation to their volume while small cells of the same shape have more surface area.

Explanation:

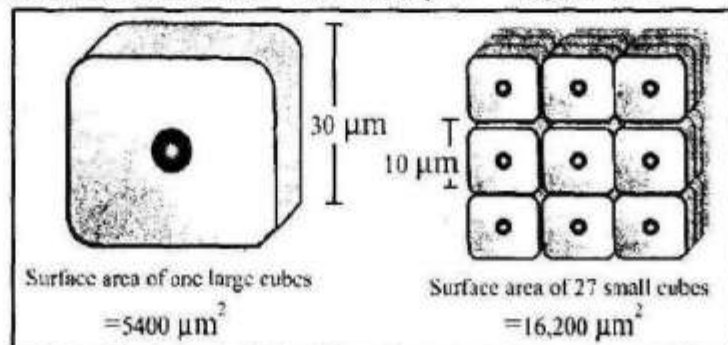
Figure below illustrate the surface area to volume relationship (سطحی رقبہ کا حجم سے تعلق) using cube-shaped (مکعب نما) cells. The figure shows 1 large cell and 27 small cells. In both cases, the total volume is the same:

$$\text{Volume} = 30\ \mu m \times 30\ \mu m \times 30\ \mu m = 27,000\ \mu m^3$$

In contrast (برخلاف) to the total volume, the total surface areas are very different. Because a cubical shape has 6 sides, its surface area is 6 times the area of 1 side. The surface areas of the cubes are as follows:

Surface area of 1 large cube $= 6 \times (30\ \mu m \times 30\ \mu m) = 5400\ \mu m^2$

Surface area of 1 small cube $= 6 \times (10\ \mu m \times 10\ \mu m) = 600\ \mu m^2$ and

Surface area of 27 small cubes $= 27 \times 600\ \mu m^2 = 16,200\ \mu m^2$

Effect (اثر) of cell size on surface area

Relation of required nutrients with area:

The need of nutrients and rate of waste production are directly proportional (راست متناسب) to cell volume. The cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. But as the figure shows, a large cell has a much smaller surface area relative to its volume than smaller cells have. Hence we conclude (اس نتیجہ پر پہنچتے ہیں) that the membranes of small cells can serve their volumes more easily than the membrane of a large cell.

4.4. PASSAGE OF MOLECULES INTO AND OUT OF CELLS

Q.21. Explain the phenomenon involved in the passage of matter across cell membrane.

Ans: TRANSPORT ACROSS THE CELL:

Cell membranes are called **semi permeable** membranes separating the inner cellular environment from the outer environment. While exchanging matter with cell's environment, cell membranes maintain equilibrium (توازن) inside the cell as well as outside.

Phenomena of cell transport:

The control of the passage (راستہ) of molecules into and out of cells is made possible through following phenomena:

1. Diffusion
2. Facilitated diffusion
3. Osmosis
4. Filtration
5. Active transport
6. Endocytosis
7. Exocytosis

1. DIFFUSION:

Definition:

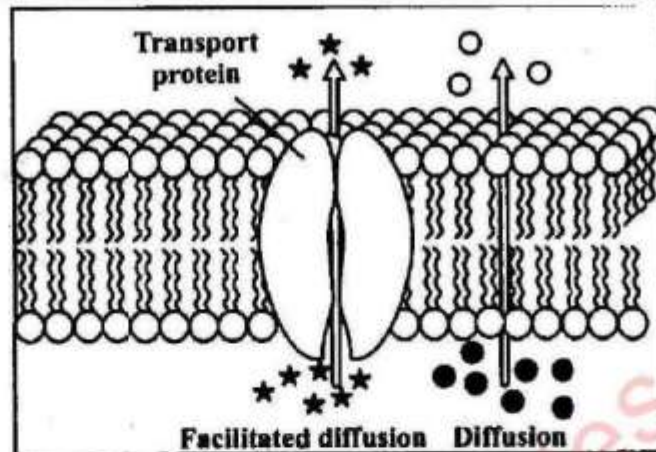
Diffusion is the net random (بے ترتیب) movement of a substance from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient.

Motion of molecules:

The molecules of any substances (solid, liquid, or gas) are in motion (حرکت) when that substance is above 0 degree Kelvin or -273°C.

Dynamic equilibrium:

In a substance, the majority (اکثریت) of the molecules move from higher to lower concentration, although there will be some that move from low to high. The overall (مجموعی) net movement is thus from high to low concentration.

Eventually (آخرکار), the molecules reach a state of equilibrium where they are distributed equally throughout the area.

Diffusion through cell membrane

Applications (اطلاقات) of diffusion:

(i) Diffusion is one principle method (اصولی طریقہ) of movement of substances within cells, as well as across cell membrane.

(ii) Carbon dioxide, oxygen, glucose etc. can cross the cell membranes by diffusion.

(iii) Gas exchange (گیسوں کا تبادلہ) in gills (گلپھڑے) and lungs occurs by this process.

(iv) Movement of glucose molecules from small intestine lumen into the blood capillaries of villi is another example of diffusion.

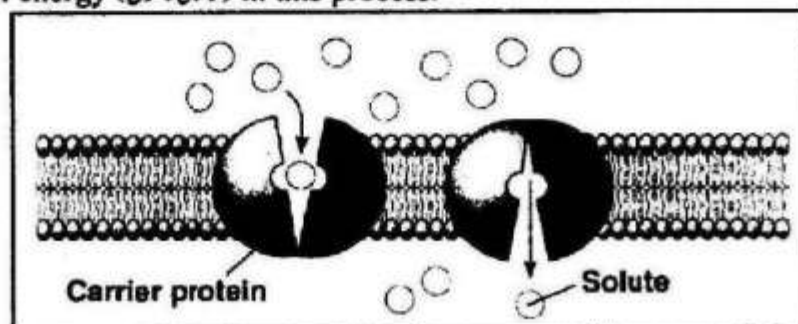
Passive transport:

In the diffusion the energy (توانائی) is not required so it is a type of passive transport.

2. FACILITATED DIFFUSION:

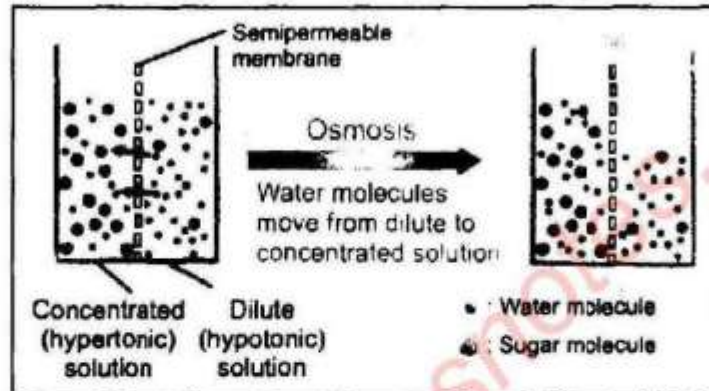
Many molecules do not diffuse freely (آزادانہ) across cell membranes because of their size or charge. Such molecules are taken into or out of the cells with the help of transport-proteins present in cell membranes. When a transport protein moves a substance from higher to lower concentration, the process is called facilitated diffusion. The rate of facilitated diffusion is higher than simple diffusion.

Passive transport:

Facilitated diffusion is also a type of passive transport because there is no expenditure of energy (توانائی کا خرچ) in this process.

Facilitated diffusion through cell membrane

3. OSMOSIS:

Definition:

Osmosis is the movement of water across a semi permeable membrane from a solution of lesser solute (حل کیا ہوا مادہ) concentration to a solution of higher solute concentration.

The rules of osmosis can be best understood through the concepts (تصورات) of tonicity of solutions:

Tonicity (قوت کشش):

The term tonicity refers to the relative concentration of solutes in the solutions being compared.

Hypertonic solution:

A hypertonic solution has relatively (نسبتاً) more solute.

Hypotonic solution:

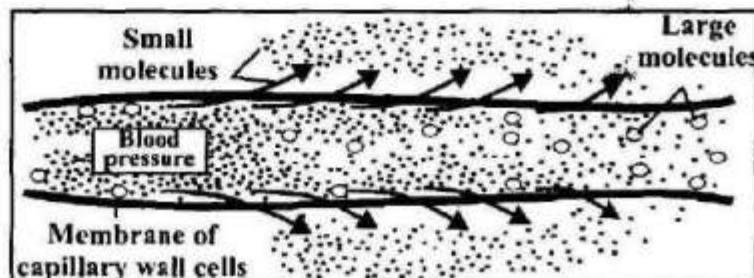
A hypotonic solution has relatively less solute.

Isotonic solution:

Isotonic solutions have equal concentration of solutes.

4. FILTRATION:

Definition:

Filtration is a process by which small molecules are forced to move across semi-permeable membrane with the aid (مدد) of hydrostatic (water) pressure or blood pressure.

Filtration through the cell membrane of capillary wall

Example:

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells.

Transport of small molecules:

In filtration the pressure cannot force large molecules, such as proteins, to pass through the membrane pores (مسام).

5. ACTIVE TRANSPORT:

Definition:

Active transport is the movement of molecules from an area of lower concentration to the area of higher concentration.

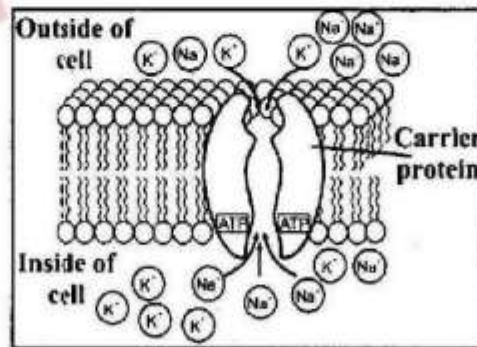
Need of energy:

This movement against the concentration gradient (درجہ) requires energy in the form of ATP.

Function of carrier proteins:

In this process, carrier (لے جانے والے) proteins of cell membrane use energy to move the molecules against the concentration gradient.

Example:

The membranes of nerve cells have carrier proteins in the form of **"sodium-potassium pump"**. In a resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain higher concentrations of K^+ and lower concentrations of Na^+ inside the cell. For this purpose, the pump actively (تیزی سے) moves Na^+ to the outside of the cell where they are already in higher concentration. Similarly this pumps moves K^+ from outside to inside the cell where they are in higher concentration.

Sodium-potassium pump, showing active transport

6. ENDOCYTOSIS:

Definition:

It is the process of cellular ingestion (نگلنا) of bulky (بھاری) materials by the infolding of cell membrane.

Forms of Endocytosis:

There are two forms of endocytosis.

(i) Phagocytosis (cellular eating) *(ii)* Pinocytosis (cellular drinking)

(i) ***Phagocytosis:***

In phagocytosis cell takes in solid material.

(ii) ***Pinocytosis:***

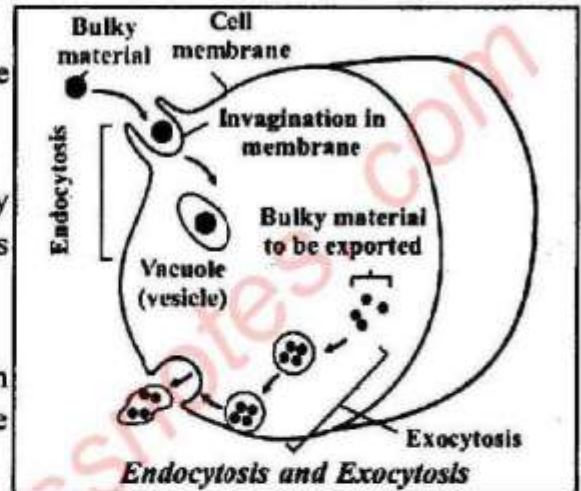
In pinocytosis cell takes in liquid in the form of droplets (ننھی بوندیں).

7. EXOCYTOSIS:

It is the process through which bulky material is exported (خارج کیا جاتا ہے). Exocytosis occurs in following steps:

Importance of exocytosis:

This process adds new membrane which replaces (تبدیل کرتی ہے) the part of cell membrane lost during endocytosis.

Endocytosis and Exocytosis

Q.22. Explain what would happen when a plant and an animal cell is placed in a hypotonic solution, isotonic solution or in hypertonic solution.

Ans: TONICITY:

The term tonicity refers to the relative concentration of solutes in the solutions being compared.

There are three types of solutions regarding their solute concentration.

1. ***Hypertonic solutions:***

Hypertonic solutions are those in which more solute is present.

2. ***Hypotonic solutions:***

Hypotonic solutions are those with less solute.

3. ***Isotonic solutions:***

Isotonic solutions have equal (برابر) concentration of solutes.

Water Balance Problems in Animal Cells:

Cells in isotonic solution:

When a red blood cell (animal cell), is placed in an isotonic solution, the cell volume remains constant (مستقل) because the rate at which water is entering the cell is equal to the rate at which it is moving out.

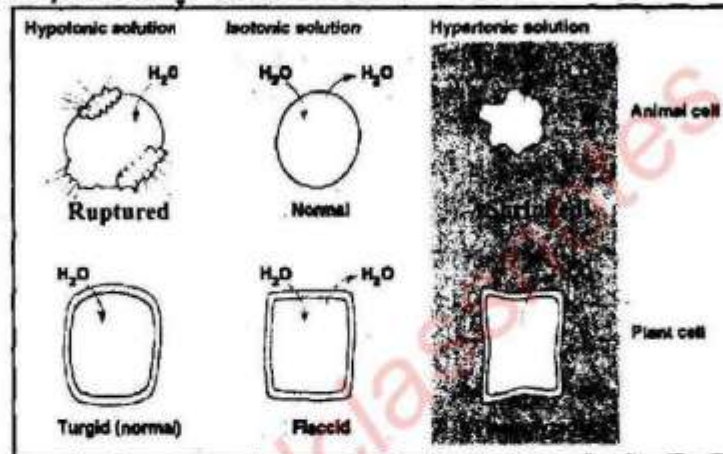
Cells in hypotonic solution:

When a red blood cell is placed in a hypotonic solution (which has lower salt concentration than the cell) water enters and the cell swells (پھول جاتا ہے) and may rupture (پھٹ سکتا ہے) like an over-filled balloon.

Cells in hypertonic solution:

When a red blood cell is placed in a hypertonic solution (which has higher salt concentration than the cell) it will lose water and will shrink (سکڑ جانا) in size.

Ability of cell to stable the tonicity:

In hypotonic environments (e.g. freshwater) animal cells must have ways to prevent excessive (بہت زیادہ) entry of water and in hypertonic environments (e.g. seawater) they must have ways to prevent (روکنا) excessive loss of water.

Effect of tonicity on animal and plant cell

Water balance problems in plant cells:

Water balance problems are somewhat different for plant cells because of their rigid cell walls.

Cells in hypotonic solution:

Most plant cells live in hypotonic environment (ماحول) because there is low concentration of solutes in extracellular fluids than in cells. As a result, water tends to move first inside cell then inside vacuole, when vacuole increases in size, cytoplasm presses firmly against the interior of the cell wall, which expands a little. Due to strong cell wall, plant cell does not rupture but instead becomes rigid (سخت). The internal pressure of such a rigid cell is known as turgor pressure and this phenomenon is known as turgor.

Cells in isotonic solution:

In isotonic environment the plant cell is flaccid (loose/not firm), because the net uptake of water is not enough to make the cell turgid.

Cells in hypertonic solution:

In a hypertonic environment a plant cell loses water, and cytoplasm shrinks. The shrinking of cytoplasm is called plasmolysis.

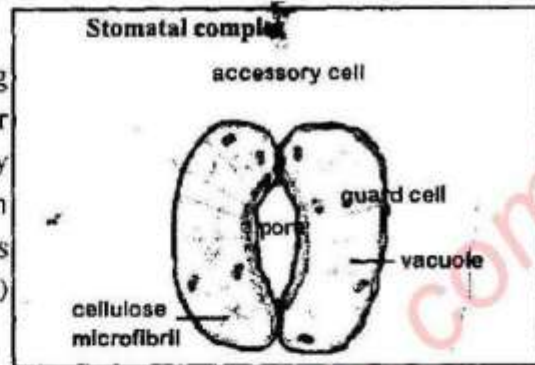
Q.23. Write a note on opening and closing of stomata.

Ans: Opening and Closing of Stomata:

Guard cells:

Stomata (openings) in leaf epidermis are surrounded (گھرے ہوئے) by guard cells.

Process in day time:

During daytime guards cells are making glucose and so are hypertonic (have higher concentration of glucose) than their nearby (نزدیکی) epidermis cells. Water enters them from other cells and they swell (پھول جاتے ہیں). In this form, they assume a rigid bowed (کمان جیسی) shape, creating a pore between them.

Process in night:

At night when there is low solute concentration in guard cells, water leaves them and they become flaccid (ڈھیلا). In this form, both guard cells rest against one another and opening is closed.

Application of knowledge about semi-permeable membranes:

The knowledge about semi-permeable membranes is applied for various purposes. Semi-permeable membrane is capable of separating substances.

Application of artificially (مصنوعی) synthesized semi-permeable membrane:

(i) Artificially synthesized semi-permeable membranes are used for separation of bacteria from viruses, because bacteria cannot cross a semi-permeable membrane.

(ii) In advanced water-treatment technologies membrane-based filtration systems are used. Semi-permeable membranes efficiently (مستعدی سے) separate salts (نمکیات) from water under pressure. This process is also called reverse osmosis.

4.5 ANIMAL AND PLANT TISSUES

Q.24. Describe the major animal tissues (epithelial, connective, muscle and nervous) in terms of their cell specificities, locations and functions.

Ans: ANIMAL TISSUES:

There are four major categories of tissues in animals.

A. Epithelial tissue B. Connective tissue
C. Muscle tissue D. Nervous tissue

A. EPITHELIAL TISSUE:

Epithelial tissue covers the outside of the body and lines organs and cavities. The cells in this tissue are very closely packed together. This tissue is commonly classified on the base of the shape of the cells as well as the number of cell layers (تہیں). Some types include:

I. Squamous Epithelium:

Structure: These are composed of a single layer of flat cells.

Location: These tissues are found in lungs, heart and blood vessels etc.

Function: This tissue allows the movement of materials across it.

2. ***Cuboidal Epithelium*** (جسم کی بالائی سطح تشکیل دینے والا ریشہ) **:**

Structure: Simple cuboidal epithelial tissues consist of single layer of cube-shaped (مکعب نما) cells.

Location: These tissues are found in kidney (گردے) tubes, small glands, etc.

Function: This tissue makes secretions.

3. ***Columnar Epithelium:***

Structure: This tissue consists of single layer of elongated (لمبوترے) cells.

Location: These tissues are found in alimentary canal and gallbladder, etc.

Function: This tissue makes secretions.

4. ***Ciliated Columnar Epithelium:***

Structure: These tissues has elongated cells with cilia.

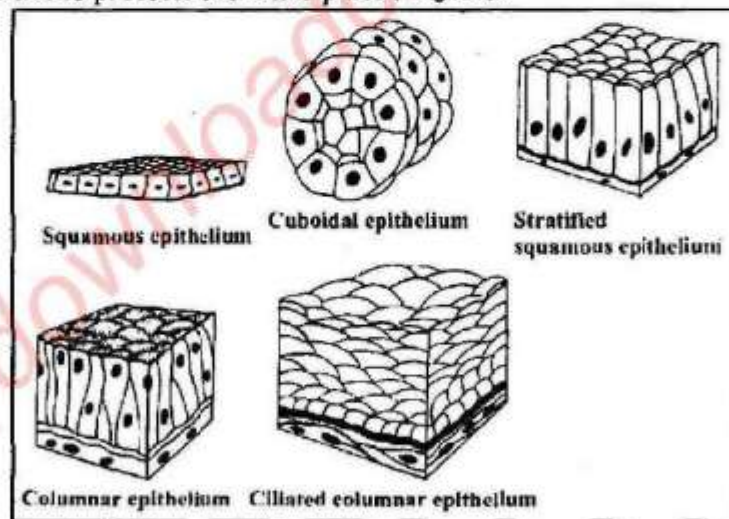
Location: These tissues are found in trachea and bronchi.

Function: This tissue propels mucous.

5. ***Stratified*** (درجہ بدرجہ تہوں والا) ***Squamous Epithelium:***

Structure: This tissue consists of many layers of flat cells.

Location: These tissues are found in the lining of oesophagus, mouth, and at the surface of the skin.

Function: This tissue protects the inner parts (اندرونی حصے).

Epithelial tissues in animals

B. CONNECTIVE TISSUES:

Connective tissue serves a "connecting (ملانے والا)" function. It supports and binds other tissues. Unlike epithelial tissue, connective tissue has cells scattered (بکھرے ہوئے) throughout an extracellular matrix.

Examples:

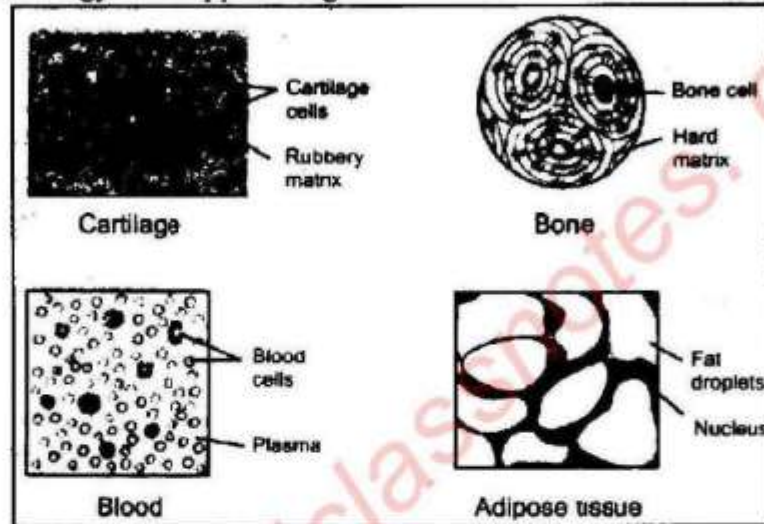
Cartilage:

Common examples of this tissue are cartilage (found around the ends of bones, in

external ear, nose, trachea etc.), bone and blood.

Adipose tissue:

The adipose tissue (found around kidneys, under skin, in abdomen (پیٹ) etc, is also a type of connective tissue.

It provides energy and supports organs.

Connective tissues in animals

C. MUSCLE TISSUES:

Muscle tissue consists of bundles of long cells called muscle fibers. It is the most abundant (زیادہ پایا جانے والا) tissue in an animal. The cells of this tissue have ability to contract.

Kinds of Muscle Tissues:

There are three kinds of muscle tissue in vertebrates:

1. Skeletal Muscles *2.* Smooth Muscles
3. Cardiac Muscles

1. SKELETAL MUSCLES:

Structure: These composed of striated (striped) (دھاری دار) cells and contain many nuclei.

Location: These are found attached to bones.

Function: These are responsible for movements of bones. These muscles are voluntary (اپنی مرضی سے) in action.

2. SMOOTH MUSCLES:

Structure: These are composed of non-striated (smooth) cells each contains a single nucleus.

Location: These are found in the walls of digestive tract, urinary bladder, blood vessels etc.

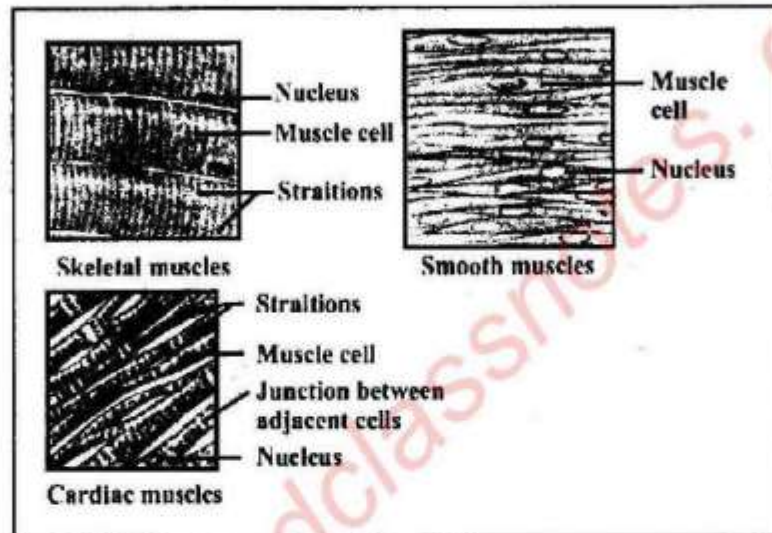
Function: These are responsible for the movement of substances. Smooth muscles are involuntary in action.

3. CARDIAC MUSCLES:

Structure: These are composed of striated cells and each contains a single nucleus.

Location: These are found in the wall of the heart.

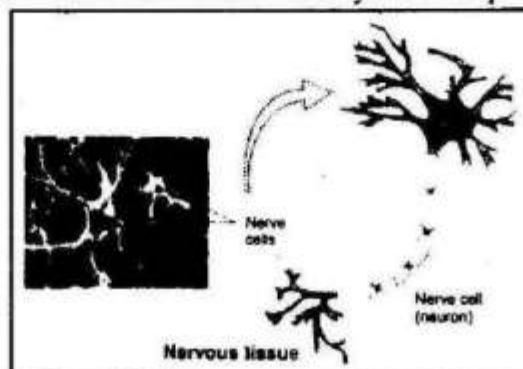
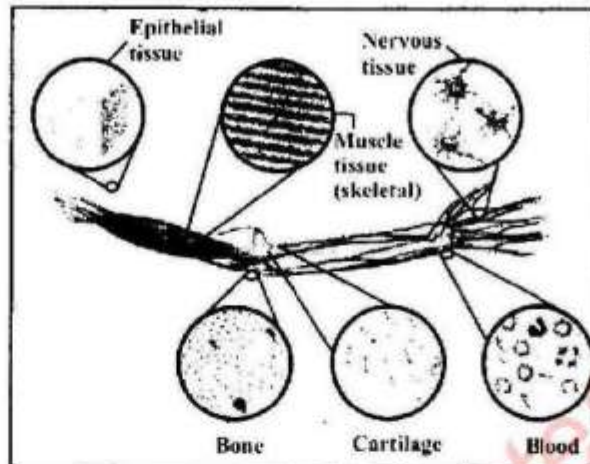
Function: The cardiac muscles produce heartbeat (دل کی حرکت). Cardiac muscles are involuntary (غیر رضا کارانہ) in action i.e. their contraction (سکڑنا) is not under control of our will (مرضی).

Types of muscle tissue

D. NERVOUS TISSUE:

Importance: An animal's survival (زندہ رہنا) depends on its ability to respond appropriately to the stimuli from its environment. This ability requires the transmission (منتقلی) of information among the parts of body. It is provided by nervous tissues.

Structure: This tissue is mainly composed of nerve cells or neurons.

Location: Nervous tissue is found in brain (دماغ), spinal cord (ریڑھ کی ہڈی) and nerves (اعصاب).

Function: Nervous tissues are specialized to conduct messages in the form of **nerve impulses**. Nervous tissue forms a communication system and performs this task.

Neurons in human body

Different tissues in human body

4.5.2 PLANT TISSUES

Q.25. Describe the major plant tissues i.e. simple tissues (meristematic tissues, permanent (tissues) and compound tissues (xylem tissues and phloem tissues) in terms of their cell specificities, locations and functions.

Ans: The cells of plants are grouped into tissues with characteristic functions such as photosynthesis, transport etc.

Major categories of plant tissue:

There are two major categories of tissues in plants.

(i) Simple (سادہ) tissues *(ii)* Compound (مرکب) tissues.

Simple Tissues:

The tissues which are made of single type of cells are called simple tissues.
They are of two types i.e.

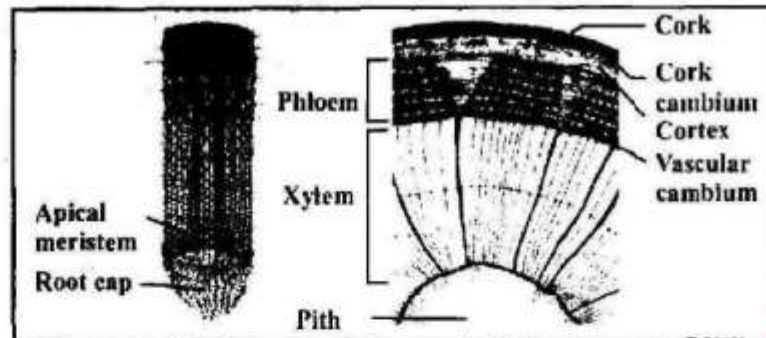
(a) meristematic tissues *(b)* permanent tissues.

A- Meristematic Tissues:

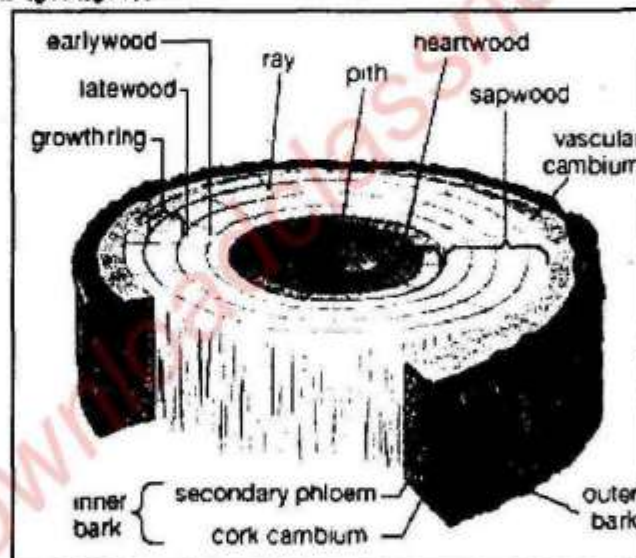
These tissues are composed of cells, which have the ability to divide (تقسیم ہونے کی اہلیت).
The cells of meristematic tissues show following properties.

(i) They have large nucleus in the center and with small or no vacuoles.
(ii) They are thin-walled (پتلی دیواریں).
(iii) They do not have inter-cellular (خلیوں کے درمیان) spaces among them.

Two main types of meristematic tissues are recognized in plants.

i. **Apical meristems** are located at the apices or tips of roots and shoot. When they divide they cause increase in the length of plant. Such growth is called **primary growth** (ابتدائی بڑھوتری).

a. Longitudinal (لمبائی رخ) section of root tip *b. Transverse (عرضی) section of stem*

a. Apical meristem at root tip *b. Vascular and cork cambium in stem*

ii. **Lateral meristems** are located on the lateral (پہلوئی طرف) sides of roots and shoot. By dividing, they are responsible for increase in girth of plant parts. Such a growth is called **secondary growth** (ثانوی بڑھوتری).

Vascular and cork cambium in stem

Lateral meristems are further of two types i.e.

(1) Vascular cambium *(2)* Cork cambium

(1) Vascular cambium:

Vascular cambium is located between xylem and phloem.

(2) Cork cambium:

Cork cambium is located in the outer lateral sides of plant.

B- Permanent Tissues:

Permanent tissues originate (نکلتے ہیں) from the meristematic tissue. The cells of these tissues do not have the ability to divide. They are further classified into following types:

1. Epidermal Tissues:

Epidermal tissues are composed of a single layer of cells.

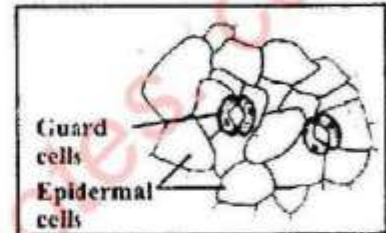
Functions:

1. These tissues cover the plant body.
2. These tissues act as a barrier (حد) between the environment and the internal plant tissues.
3. These are also responsible for the absorption of water and minerals in the roots.
4. On stem (تنا) and leaves they secrete cutin (the coating of cutin is called cuticle) which prevents evaporation.

Specialized cells:

Epidermal tissues also have some specialized cells those perform specific functions. For example:

a. Root hairs absorb water and minerals (معدنیات).

b. Stomata helps in the exchange (تبادلہ) of gases.

Epidermal tissue

2. ***Ground Tissues:***

Ground tissues are simple tissues made up of parenchyma cells.

Parenchyma cells:

Parenchyma cells are the most abundant (بہت پائے جانے والے) cells in plants.

Ground tissue

Structure of parenchyma cells:

Overall they are spherical (گنبدنما) but flat at point of contact. They have thin primary cell walls and have large vacuoles for storage of food.

Ground tissues in leaves:

In leaves, they are called mesophyll and are the sites of photosynthesis.

Ground tissues in other parts:

In other parts they are the sites of respiration (تنفس) and protein synthesis.

3. ***Support Tissues:***

These tissues provide strength (مضبوطی) and flexibility (لچک) to the plants.

Types: These are further of two types.

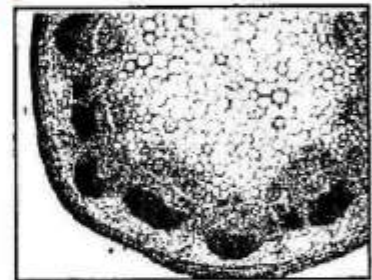
i. ***Collenchyma Tissue:***

Location: These are found in cortex of young stems and in the midribs of leaves and in petals (پتیاں) of flowers.

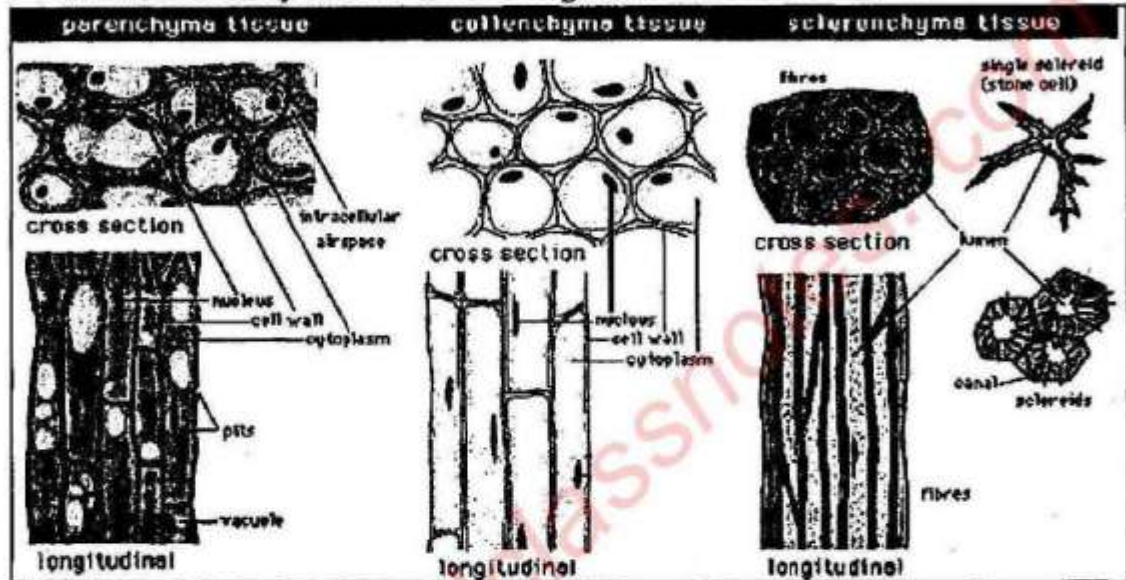
Structure: These are made of elongated cells with unevenly (غیر ہموار) thickened primary cell walls.

Function: These are flexible and function to support the organs in which they are found.

ii. ***Sclerenchyma Tissue:***

Structure: They are composed of cells with rigid secondary cell walls. Their cell walls

are hardened with lignin (مرکب نامیاتی مادہ), which is the main chemical component (جز) of wood.

Nature of sclerenchyma cells:

Mature sclerenchyma cells cannot elongate and most of them are dead.

Parenchyma tissue *Sclerenchyma tissue* *Collenchyma tissue*

Compound (Complex) Tissues:

A plant tissue composed of more than one type of cell is called a compound or complex tissue. Xylem and phloem tissues, found only in vascular plants, are examples of compound tissues.

1. Xylem Tissue:

Transport (ترسیل) of water and minerals:

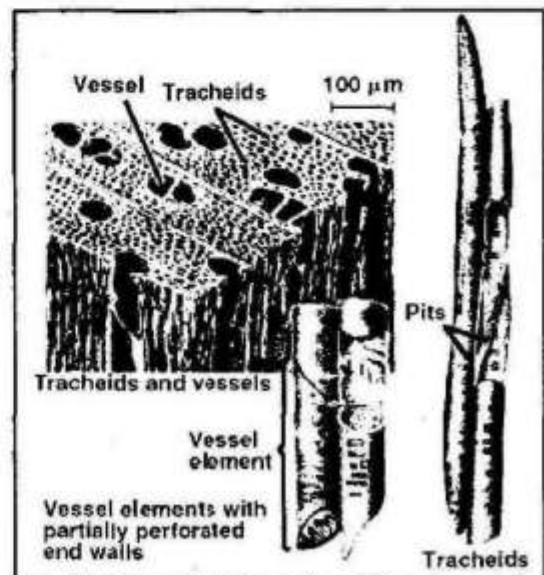
Xylem tissue is responsible for the transport of water and dissolved (حل شدہ) substances from roots to the aerial parts.

Provide support to plant:

Due to the presence of lignin, the secondary walls of its cells are thick and rigid. That is why xylem tissue provides support to the plant body.

Types of cells in xylem tissue:

a- Vessel elements or cells:

These have thick (موٹی) secondary cell walls. They lack end walls and join together to form long tubes.

Xylem tissue

b- *Tracheids:*

These are slender (باریک) cells with overlapping (ڈھانپ لینا) ends (کنارے).

2. *Phloem Tissue:*

Phloem tissue is responsible for the conduction (ایصال حرارت) of dissolved organic matter (food) between different parts of the plant body.

Types of cells in phloem tissues:

Following types of cell are found in phloem tissue;

1. Sieve tube cells *2.* Companion cells

A. *Sieve tube cells:*

These are long cells and their end walls have small pores. Many sieve tube cells join to form long sieve tubes.

B. *Companion cells:*

Companion cells make proteins for sieve tube cells.

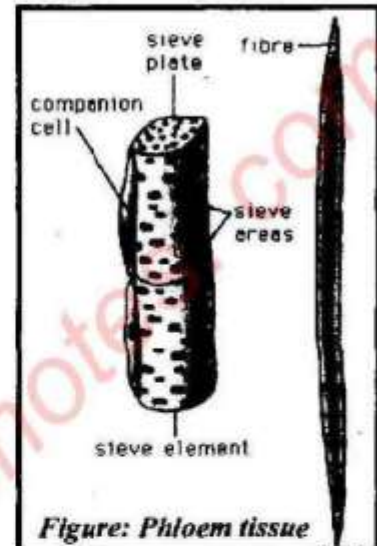



Figure: Phloem tissue

Review Questions

MULTIPLE CHOICE

1. Which of these clues would tell you whether a cell is prokaryotic or eukaryotic?

(a) The presence or absence of a cell wall
(b) Whether or not the cell is partitioned by internal membranes
(c) The presence or absence of ribosomes
(d) Whether or not the cell contains DNA

2. There are_________ micrometers (μm) in one millimeter (mm).

(a) 10 (b) 100 (c) 1000 (d) 1/1000

3. The plasma membrane does all of these except_________.

(a) Contains the hereditary material
(b) Acts as a boundary or border for the cytoplasm
(c) Regulates passage of material in and out of the cell
(d) Functions in the recognition of cell

4. Which of these materials is not a component of the plasma membrane?

(a) Lipids (b) Carbohydrates (c) Proteins (d) DNA

5. Cells walls are found in these organisms, except for.

(a) Plants (b) Animals (c) Bacteria (d) Fungi

6. **The ________ is a major component of plant cell walls.**
   (a) Chitin (b) Peptidoglycan (c) Cellulose (d) Cholesterol
7. **Plant cells have ______ and ______, which are not present in animal cells.**
   (a) Mitochondria, chloroplasts (b) Cell membranes, cell walls
   (c) Chloroplasts, nucleus (d) Chloroplasts, cell wall
8. **The _______ is the membrane enclosed structure in eukaryotic cells that contains the DNA of the cell.**
   (a) Mitochondrion (b) Chloroplast (c) Nucleolus (d) Nucleus
9. **Ribosomes are constructed in the ________.**
   (a) Endoplasmic reticulum (b) Nucleoid
   (c) Nucleolus (d) Nuclear pore
10. **Rough endoplasmic reticulum is the area in a cell where ____ are synthesized.**
    (a) Polysaccharides (b) Proteins (c) Lipids (d) DNA
11. **Smooth endoplasmic reticulum is the area in a cell where ___ are synthesized.**
    (a) Polysaccharides (b) Proteins (c) Lipids (d) DNA
12. **The mitochondrion functions in ________.**
    (a) Lipid storage (b) Protein synthesis
    (c) Photosynthesis (d) Cellular respiration
13. **The thin extensions of the inner mitochondrial membrane are known as ________.**
    (a) Cristae (b) Matrix (c) Thylakoids (d) Stroma
14. **The chloroplast functions in ________.**
    (a) ATP synthesis (b) Protein synthesis
    (c) Photosynthesis (d) DNA replication
15. **Which of these cellular organelles have their own DNA?**
    (a) Chloroplast (b) Nucleus (c) Mitochondria (d) All of these

Ans: **1.** Whether or not the cell is partitioned by internal membranes **2.** 1000
3. Contains the hereditary material **4.** DNA **5.** Animals
6. Cellulose **7.** Chloroplasts, cell wall **8.** Nucleus
9. Nucleolus **10.** Proteins **11.** Lipids **12.** Cellular respiration
13. Cristae **14.** Photosynthesis **15.** All of these

UNDERSTANDING THE CONCEPTS

1. Explain the functions of cell membrane.

Ans: Refer to Q.No.9 for answer.

2. Describe the structure of cell wall.

Ans: Refer to Q.No.6 for answer.

3. *Discuss nucleus structure and function.*

Ans: Refer to Q.No.13 for answer.

4. *Describe the structure and function of endoplasmic reticulum and Golgi apparatus.*

Ans: Refer to Q.No.15 for answer.

5. *Describe the formation and function of lysosomes.*

Ans: Refer to Q.No.16 for answer.

6. *Explain what would happen when a plant and an animal cell is placed in a hypertonic solution.*

Ans: Refer to Q.No.24 for answer.

7. *Describe the internal structure of chloroplast and compare it with that of mitochondrion.*

Ans: Internal Structure of Chloroplast:

The chloroplast is the organelle where photosynthesis occurs in photosynthetic eukaryotes. The organelle is surrounded by a double membrane. Inside the inner membrane is a complex mixture of enzymes and water. This is called stroma and is important as the site of the dark reactions, more properly called the Calvin cycle.

Embedded in the stroma is a complex network of stacked sacs. Each stack is called a granum and each of the flattened sacs which make up the granum is called a thylakoid.

Similarities between chloroplasts and mitochondria:

1. Both are present in eukaryotic cells.
2. Both are related to energy transfer.
3. They both are related to carbon cycle.
4. Both have a double membrane boundary.
5. Both possess their own DNA.
6. Protein synthesis takes place in both structures.

Differences between chloroplasts and mitochondrion

Chloroplast	*Mitochondria*
Chloroplast contains thylakoid membranes and pigment molecules	the mitochondria membranes contain respiratory enzymes not found in chloroplast
In chloroplasts photosynthesis takes place.	Mitochondria help in respiration.
Chloroplasts are larger and have greater complexity.	Mitochondria are smaller and have lesser complexity.
Chloroplasts are found only in plant cells.	Mitochondria are to be found in both plant and animal cells.

8. Explain the phenomena involved in the passage of matter across cell membrane.

Ans: Refer to Q.No.23 for answer.

9. Describe how turgor pressure develops in a plant cell.

Ans: As most plant cells live in a solution of high water potential, water molecules tend to move inside the cells. Cytoplasm presses firmly against the interior of the cell wall, which expands a little. Due to a rigid cell wall, plant cell does not rupture but instead becomes rigid. The internal pressure of such a rigid cell is known as turgor pressure and this phenomenon is known as turgor.

10. State the relationship between cell function and cell structure.

Ans: Refer to Q.No.21 for answer.

11. Describe the differences in prokaryotic and eukaryotic cells.

Ans: Refer to Q.No.20 for answer.

12. Explain how surface area to volume ratio limits cell size.

Ans: Refer to Q.No.20 for answer.

13. Describe the major animal tissues in terms of their cell specificities, locations and functions.

Ans: Refer to Q.No.24 for answer.

14. Describe the major plant tissues in terms of their cell specificities, locations and functions.

Ans: Refer to Q.No.25 for answer.

SHORT QUESTIONS

1. State the cell theory.

Ans: Cell theory includes the following principles.

(i) All organisms are composed of one or more cells.

(ii) Cells are the smallest living things, the basic unit of organization of all organisms.

(iii) Cells arise only by divisions in previously existing cells.

2. What are the functions of leucoplasts and chromoplasts?

Ans: ***Leucoplasts:*** The function of leucoplasts is to store food in the form of starch, proteins and lipids.

Chromoplasts: The function of chromoplasts is the give bright colour to the flower petals and fruits. These bright colours help them in pollination and dispersal of fruit.

3. Differentiate between diffusion and facilitated diffusion?

Ans:

Diffusion	*Facilitated diffusion*
Diffusion is the movement of molecules from an area of higher concentration to the area of lower concentration. i.e. along concentration gradient.	Facilitated diffusion is the movement of molecules from an area of higher concentration to the area of lower concentration with the help of carrier proteins. i.e. along concentration gradient.

4. What is meant by hypertonic and hypotonic solutions?

Ans: The solution which has relatively more solute is called hypertonic solution.
The solution which has relatively less solute is called hypotonic solution.

THE TERMS TO KNOW

Active transport:

The movement of molecules or substance from their lower concentration to their higher concentration by the use of energy.

Cell:

Cell is the basic structural and functional unit of life.

Cell membrane:

All prokaryotic and eukaryotic cells have a thin and elastic membrane covering the cytoplasm is cell membrane. It is semi-permeable in nature.

Cell theory:

Cell theory is presented by Schleiden and Schwann. It is regarded as one of the most fundamental knowledge in biology about basic unit of life.

Cell wall:

Cell wall is a non-living and strong component of cell, located outside the plasma membrane in plants, fungi and many plant-like protist.

Centriole:

Animals and many unicellular organisms have hollow and cylindrical organelles known as centrioles. It helps in the formation of spindle fibers during cell division.

Chloroplast:

Chloroplasts are the sites of photosynthesis in eukaryotes.

Chromoplast:

Chromoplasts in plants contain pigments associated with bright colors and are present in the cells of flower petals and fruits.

Connective tissue:

Connective tissue serves a connecting function. It supports and binds other tissues.

Cytoplasm:

Cytoplasm is the semi-viscous and semi-transparent substance between plasma membrane and nuclear envelope.

Diffusion:

Movement of molecules from their higher concentration to their lower concentration is called diffusion.

Endoplasmic reticulum:

Endoplasmic reticulum is a network of inter connected channels that extends from cell membrane to nuclear envelope.

Epithelial tissue:

Epithelial tissue covers the outside of body and lines organs and cavities.

Facilitated diffusion:

The movement of molecules from their higher concentration to their lower concentration with the help of carrier protein is called facilitated diffusion.

Golgi apparatus:

In the cell, the complete set of flattened sacs (cisternae) is called golgi apparatus. It is discovered by Camillo Golgi.

Hypertonic solution:

A hypertonic solution has relatively more solute.

Hypotonic solution:

A hypotonic solution has relatively less solute.

Isotonic solution:

Isotonic solution have equal concentrations of solutes.

Leucoplast:

Leuoplasts are the type of plastid. They are colourless and store, starch, proteins and lipids.

Lysosome:

Lysosoms are single-membrane bounded organelles, contain strong digestive enzymes and work for the breakdown of food and waste materials in the cells.

Mitochondrion:

Mitochondria are double membrane-bounded structures found only in eukaryotes. These are major energy production centres.

Muscle tissue:

Muscle tissue undergoes contraction and share role in movements in animal body.

Nucleus:

Nucleus is an organelle of the cell which controls all its activity and also called the brain of the cell.

Organelle:

Organelle is a small structure with in cells that perform dedicated function.

Osmosis:

Osmosis is the movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.

Passive transport:

Movement of substance from their higher concentration to lower concentration is called passive transport. Energy is not needed in this process.

Phagocytosis:

It is a type of endocystosis in which cell ingest a solid particle by the infolding of cell membrane.

Pinocytosis:

It is a type of endocytosis in which cell takes a liquid in the form of droplets.

Plasmolysis:

The shrinkage of cytoplasm is called plasmolysis.

Plastid:

Plastid is a membrane-bound organelle that only occur in the cells of plants and photosynthetic protists.

Ribosome:

Ribosomes are the sites of protein synthesis. These are tiny granular structures that are either floating freely in cytoplasm or are bound.

Semi permeable:

Semi-permeable means a membrane which allows some specific molecules to pass.

Tissue:

Group of similar cells specialized for performance of a common function is called tissue.

Turgor pressure:

The outward pressure on cell wall exerted by internal water is known as turgor pressure.

INITIATING AND PLANNING

1. Assess the capabilities of animal and plant cell types owing to the presence or absence of chloroplasts and cell wall.
2. Assess the capabilities of prokaryotic and eukaryotic cells owing to the presence or absence of nucleus and mitochondria.

3. Label the six points given in the following diagram of a cell.
4. Justify why a colony of cells does not get tissue level of organization in spite of having many cells.
5. Formulate operational definitions of major variables e.g. define concentration gradient; define osmosis in terms of hypotonic, hypertonic and isotonic solutions.

ACTIVITIES

1. Use microscope to observe movements of water in plants and to compare sizes of various types of cells.
2. Examine, under the microscope, an animal cell (e.g. from frog's blood) and a plant cell (e.g. from onion epidermis, using an appropriate stain).
3. From fresh preparations, identify the different structures in a plant cell.
4. Prepare wet mounts of tissue from flowering plants and study plant and animal tissues from charts and prepared slides.
5. Determine the effect of tonicity on plasmolysis in plant cells and on red blood cell.
6. Collect data on the number of stomata per unit area on various plant leaves that grow in areas of differing humidity, and compile data in the form of graph it to determine whether there is a relationship between the variables.

SCIENCE, TECHNOLOGY AND SOCIETY

1. Draw analogies between division of labour in cells and in communities.
2. Conceptualize how the developments in microscopy were related to the development of cell theory.
3. Investigate the diagnostic and research applications of the electron microscope.
4. Investigate careers that require an understanding of cell biology.
5. Describe how knowledge about semi-permeable membranes, diffusion and osmosis is applied in various contexts.

ON-LINE LEARNING

- www.columbia. edu
- www.agen.ufl.edu/.../lect/lect__15/lect__15.htm
- http://sps. k12.ar.us/massengale/biology %201%page.htm
- www.cell-research.com

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ Tick the correct answer.

1. **Which Tissues form Communication System of the body?** (LHR. GI)
   (A) Supporting Tissues (B) Muscle Tissues
   (C) Simple Tissues (D) Nerve Tissues
2. **The wall of prokaryotes is composed of:** (LHR. GI)
   (A) Lignin (B) Cellulose (C) Peptidoglycan (D) Chitin
3. **Who developed first microscope?** (LHR. GII)
   (A) Robert Hooke (B) Louis Pasteur (C) Robert Brown (D) Zacharias Janssen
4. **The resolution of modern electron microscope is ________.** (GRW. GI)
   (A) 0.2 nm (B) 0.3 nm (C) 0.1 nm (D) 0.12 nm
5. **Golgi was given Nobel prize in ______.** (GRW. GI)
   (A) 1908 (B) 1807 (C) 1906 (D) 1916
6. **The life of red blood cells is ______ days.** (GRW. GI)
   (A) 120 (B) 130 (C) 180 (D) 90
7. **Solution which contains more solute is called:** (GRW. GII)
   (A) hypotonic (B) hypertonic (C) isotonic (D) none of these
8. **Cell wall of fungi is made up of:** (GRW. GII)
   (A) cellulose (B) peptidoglycan (C) chromatin (D) chitin
9. **The size of human red blood cell is:** (FBD. GI, LHR. GI, RWP. GII)
   (A) 2μm (B) 4μm (C) 6μm (D) 8μm
10. **The use of microscope is known as:** (FBD. GII)
    (A) Photography (B) Endoscopy (C) Microscopy (D) Micrography
11. **The process of taken in liquid in the form of droplets is called:** (FBD. GII)
    (A) Diffusion (B) Phagocytosis (C) Exocytosis (D) Pinocytosis
12. **The major component of plant cell walls is:** (MLN. GI)
    (A) Chitin (B) Peptidogylycan (C) Cellulose (D) Cholesterol
13. **____ tissue also makes the glandular tissue in animals.** (MLN. GI)
    (A) Nervous Tissue (B) Epithelial Tissue
    (C) Connective Tissue (D) Muscular Tissue
14. **The Chloroplast function is:** (MLN. GI)
    (A) ATP synthesis (B) Protein synthesis

(C) Photosynthesis (D) DNA replication

15. _______ suggested a Biological Principle that "all living cells arise from pre-exiting cells". (MLN. GII)

(A) Schleiden (B) Robert Brown (C) Louis Pasteur (D) Rudolf Virchow

16. _______ is not a component of cell membrane. (MLN. GII)

(A) DNA (B) Lipids (C) Protein (D) Carbohydrates

17. Magnification of light microscope is: (MLN. GII)

(A) 1300 X (B) 1400 X (C) 1500 X (D) 1600 X

18. Cell membrane mainly composed of: (SWL. GI, DGK. GI, RWP. GII)

(A) proteins and lipids (B) cholesterol
(C) lignin (D) peptidoglycan

19. Scientist who described the cell first time: (SWL. GII)

(A) Aristotle (B) Robert Hooke (C) Robert Brown (D) Leeuwenhoek

20. Human body is made up of types of cells: (SWL. GII)

(A) 50 (B) 100 (C) 150 (D) 200

21. The stack of thylakoids is called ___________. (SGD. GI, GRW. GI)

(A) Stroma (B) Cristae (C) Granum (D) Leucoplast

22. Those plastids which are colourless: (SGD. GI)

(A) Chloroplast (B) Leucoplasts (C) Chromoplast (D) Lipids

23. Prepare proteins in the cell: (SGD. GII, SWL. GI, DGK. GI & GII)

(A) Ribosomes (B) Mitochondria (C) Golgi complex (D) Vacuole

24. Only few molecules can pass through it: (SGD. GII)

(A) Permeable membrane (B) Semi-Permeable membrane
(C) Non-Permeable membrane (D) Cell wall

25. The photograph taken by microscope is called. (RWP. GI)

(A) Photograph (B) Tonograph (C) Micrograph (D) Cardiograph

26. "All cells are formed from pre-existing cells" is the saying of: (RWP. GI)

(A) Rudolf Virchow (B) Pasteur (C) Robert Hook (D) Darwin

27. The chemical substance secreted by the epidermis of leaves is: (RWP. GII)

(A) Cutin (B) Lignin (C) Aspirin (D) Albumen

28. Nervous Tissue is found in: (DGK. GI)

(A) Brain (B) Spinal Cord (C) Nerves (D) All A, B and C

29. Which is not present in cell membrane? (DGK. GII)

(A) DNA (B) Lipids (C) Proteins (D) Carbohydrates

30. The function of mitochondria is: (DGK. GII, LHR. GI, MLN. GI, SGD. GI)

(A) Proteins synthesis (B) Lipid storage
(C) Cellular respiration (D) Photosynthesis

31. **In which component of the leafcell chlorophyll is present?** (DGK. GII, 2014)
    (A) Plasma membrane (B) Thylakoids
    (C) Cytoplasm (D) Stroma
32. **Which of these tissues also makes the glaundular tissue in animal?** (DGK. GII)
    (A) Connective tissue (B) Muscular tissue (C) Nervous tissue (D) Epithelial tissues
33. **Resolution Power of Human Eye is:** (BWP. GI)
    (A) 0.1 mm (B) 0.01 mm (C) 10 mm (D) 100 mm
34. **The name of Scientist who described the Cell first time is:** (BWP. GI)
    (A) Robert Brown (B) Robert Hook (C) Newton (D) Shawan
35. **Ribosomal R.N.A is produced in:** (BWP. GII)
    (A) Mitochondria (B) Nucleolus (C) Lysosomes (D) Golgi Apparatus
36. **The movement of molecules from a region of lower concentration to higer concentration is called:** (LHR. GI, RWP. GI)
    (A) Active transport (B) Osmosis (C) Diffusion (D) Filtration
37. **Which of these cell organelles have their own DNA?** (LHR. GII, SWL. GII)
    (A) Nucleus (B) Mitochondria (C) Chloroplast (D) Golgi bodies
38. **In the cell wall of plant the chemical present is:** (GRW. GI)
    (A) cellulose (B) chitin (C) potassium (D) sodium
39. **The scientist who discovered nucleus in the cell is:** (GRW. GII)
    (A) Robert Hooke (B) Robert Brown (C) Shawan (D) Schleiden
40. **The organelle which produces energy is:** (GRW. GII)
    (A) mitochondria (B) ribosome (C) nucleus (D) vacuole
41. **Use of microscope is called:** (FBD. GI)
    (A) Research (B) Microscopy (C) Micrograph (D) ATP
42. **The number of sub-units of ribosome is:** (FBD. GI)
    (A) 2 (B) 4 (C) 6 (D) 8
43. **Which is not component of cell membrane?** (FBD. GII)
    (A) Proteins (B) DNA (C) Lipids (D) Carbohydrates
44. **The thin extensions of the inner membrane of mitochondria are known as:** (FBD. GII)
    (A) Matrix (B) Cristae (C) Stroma (D) Thylakoids
45. **Ribosomes are synthesized in:** (MLN. GII)
    (A) Nucleolus (B) Nucleus
    (C) Endoplasmic Reticulum (D) None of these
46. **In body cell responsible for coordination are:** (SGD. GI)
    (A) Heart cells (B) Skin cells (C) Nerve cells (D) Bone cells

47. The roots and root hairs absorb water from soil by: (RWP. GI)
(A) Osmosis (B) Diffusion (C) Phloem (D) Air

48. Robert Hooke was a scientist: (RWP. GI)
(A) Greek (B) Iranian (C) Polish (D) British

49. Nucleus in plant cell was discovered in: (RWP. GII)
(A) 1831 A.D (B) 1834 A.D (C) 1883 A.D (D) 1664 A.D

50. The smallest cells are of some bacteria e.g. (DGK. GII)
(A) Mycoplasma (B) Cytoplasm (C) E-Coli (D) Steptocoli

51. Lysosomes were discovered by: (BWP. GI)
(A) Camillio Golgi (B) Robert Hook
(C) Christian Rene DeDuve (D) A.F.A.King

52. Function of Chloroplast is: (BWP. GII)
(A) Photosynthesis (B) ATP Formation
(C) Protein Formation (D) DNA Replication

Answers

1. Nerve Tissues	2. Peptidoglycan	3. Zacharias Janssen	4. 0.2 nm
5. 1906	6. 120	7. hypertonic	8. chitin
9. 8μm	10. Microscopy	11. Pinocytosis	12. Cellulose
13. Epithelial Tissue	14. Photosynthesis	15. Rudolf Virchow	16. DNA
17. 1500 X	18. proteins and lipids		19. Robert Hooke
20. 200	21. Granum	22. Leucoplasts	23. Ribo somes
24. Semi-Permeable membrane			
25. Micrograph	26. Rudolf Virchow	27. Cutin	28. All A, B and C
29. DNA	30. Cellular respiration	31.	Thylakoids
32. Epithelial tissues	33. 0.1 mm	34. Robert Hook	35. Nucleolus
36. Active transport	37. Mitochondria	38. cellulose	39. Robert Brown
40. mitochondria	41. Microscopy	42. 2	43. DNA
44. Cristae	45. None of these	46. Nerve cells	47. Osmosis
48. British	49. 1831 A.D	50. E-Coli	
51. Christian Rene DeDuve		52. Photosynthesis	

☆ Give short answer to the following questions.

1. What is meant by Nucleoid? (LHR. GI & GII)

Ans: Chromosome of eukaryotic consist on DNA only and float in cytoplasm near centre. This region is called nucleoid.

2. Define Filtration. (LHR. GI)

Ans: Filtration is a process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure or blood pressure.

3. Define reverse osmosis. (LHR. GII)

Ans: The process by which a solvent passes through a porous membrane in the direction opposite to that for natural osmosis, when subject a hydrostatic pressure greater than the osmotic pressure.

4. Differentiate between diffusion and facilitated diffusion. (GRW. GI, & GII)

Ans: Diffusion: Movement of molecules from their higher concentration to their lower concentration is called diffusion.

Facilitated diffusion: The movement of molecules from their higher concentration to their lower concentration with the help of carrier protein is called facilitated diffusion.

5. Write the structure of mitochondria. (GRW. GI)

Ans: Structure: Mitochondria (singular: mitochondrion) are the double membrane bounded structures found only in eukaryotes.

Outer membrane: The outer membrane of a mitochondrion is smooth.

Inner membrane: The inner membrane forms many infoldings, called cristae in the inner mitochondrial matrix.

6. What is meant by endocytosis? Write its two types.
(GRW. GI, MLN. GI, SWL. GII, SGD. GI & GII)

Ans: Endocytosis is the process of cellular ingestion of bulky materials by the infolding of cell membrane. It is of two types which are:

1. Phagocytosis (cellular eating)
2. Pinocytosis (cellular drinking)

7. Describe functions of vacuoles in a cell. (GRW. GII)

Ans:
- Many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes.
- Some unicellular organisms use contractile vacuole for the elimination of wastes from their bodies.

8. What is meant by turgor pressure? (GRW. GII, SGD. GI, FBD. GII, BWP. GII)

Ans: The outward pressure on cell wall exerted by internal water is known as turgor pressure.

9. Where ribosomes are located? What role they play? (LHR. GI, FBD. GI & GII)

Ans: Ribosomes are either floating freely in cytoplasm or bound to endoplasmic reticulum (ER).

Ribosomes are the sites of proteins synthesis.

Protein synthesis is extremely important to cells, and so large numbers of ribosomes are found throughout cells.

10. What is the role of leucoplasts and chloroplasts? (FBD. GI)

Ans: Leucoplasts are type of plastid. They are colourless and store starch, proteins and lipids. They are present in those cells where food is stored. Chloroplasts are the sites of photosynthesis in eukaryotes. They contain chlorophyll, the green pigment

necessary for photosynthesis, and associated pigments. These pigments are present in thylakoids of the grana.

11. Describe structure and function of golgi apparatus and lysosomes. (FBD. GI)

Ans: The golgi bodies are sac like structure present in plant and animal cells. These sacs can be transported to various locations in cell or to its exterior, in the form of secretions. Lysosomes are single membrane bound organelles. It act as to break down the targeted material.

12. Define osmosis. (FBD. GII, SWL. GI, RWP. GII)

Ans: Osmosis is the movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.

13. What is the function of Smooth Endoplasmic Reticulum? (MLN. GI)

Ans: **1.** It is involved in lipid metabolism and in the transport of materials from one part of the cell to the other.

2. It also detoxifies the harmful chemicals that have entered cell.

14. What do you mean by Plasmolysis? (MLN. GI, SWL. GI)

Ans: The shrinkage of cytoplasm is called plasmolysis.

15. Define "Sodium-Potassium Pump." (MLN. GII)

Ans: The membranes of nerve cells have carrier proteins in the form of "sodium-potassium pump". In resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain higher concentrations of K^+ and lower concentrations of Na^+ inside the cell. For this purpose, the pump actively moves Na^+ to the outside of the cell where they are already in higher concentration. Similarly, this pumps moves K^+ from outside to inside the cell where they are in higher concentration.

16. Differentiate between Phagocytosis and Pinocytosis. (MLN. GII, LHR. GII, DGK. GI)

Ans: **Phagocytosis:** In phagocytosis cell takes in solid material.

Pinocytosis: In pinocytosis cell takes in liquid in the form of droplets.

17. What is meant by Exocytosis? (MLN. GII)

Ans: It is the process through which bulky material is exported.

18. What is meant by magnification of microscope? (SWL. GI)

Ans: Magnification is the increase in the apparent size of an object and it is an important factor in microscopy.

19. Define plasmodesmata. (SWL. GI, BWP. GI & GII)

Ans: In the walls of neighbouring cells there are cytoplasmic connections called plasmodesmata. Through these connections, cells transfer chemicals among each other.

20. Write the function of mitochondria. (SWL. GII)

Ans: Mitochondria are the sites of aerobic respiration, and are the major energy

production centers.

21. What is endoplasmic reticulum? Write its two types. (SWL. GII)

Ans: Endoplasmic reticulum is a network of interconnected channels that extends from cell membrane to the nuclear envelope.

Types of endoplasmic reticulum: This network exists in two forms:

1. Rough Endoplasmic Reticulum (RER)
2. Smooth Endoplasmic Reticulum (SER)

22. Write one difference between Prokaryotes and eukaryotes. (SGD. GI)

Ans: Cells with out proper nucleus are called prokaryotes, while those cells which have not a proper nucleus are called eukaryotes.

23. What is meant by passive diffusion? (SGD. GI)

Ans: When a transport protein moves a substance from higher to lower concentration, the process is called facilitated diffusion. Facilitated diffusion is a passive diffusion because there is no expenditure of energy in this process. The rate of facilitated diffusion is higher than simple diffusion.

24. Why cell membrane is called semi permeable membrane? (SGD. GI)

Ans: The cell membrane functions as a semi-permeable barrier, allowing a very few molecules across it while fencing the majority of chemicals inside the cell. In this way, the cell membrane maintains the internal composition of the cell.

25. Write schleiden and schwann cell theory. (SGD. GII)

Ans: Contribution of Matthias Schleiden:

In 1838, a German botanist Matthias Schleiden studied plant tissues and made the first statement of the cell theory. He stated that all plants "are aggregates of individual cells which are fully independent."

Contribution of Theodor Schwann: In 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells. Thus Schleiden and Schwann proposed cell theory in its initial form.

26. Give a difference between prokaryotic and eukaryotic cells. (SGD. GII)

Ans:

Prokaryotic Cell	Eukaryotic Cell
Prokaryotes have a cell wall composed of peptidoglycan that is a single large polymer of amino acids and sugars.	The cell wall of eukaryotic cell is made of cellulose (in plants) or chitin (in fungi). It is absent in animal cells.
Nucleus is not very prominent	Prominent nucleus is present

27. What is scanning electron microscope? (RWP. GI)

Ans: Scanning Electron Microscope (SEM): In SEM, electrons are reflected from the metal-coated surfaces. SEM is used to study the structure of cell surfaces.

28. What is sclerenchyma tissues? (RWP. GI)

Ans: They are composed of cells with rigid secondary cell walls. Their cell walls are hardened with lignin, which is the main chemical component of wood. These tissues provide strength and flexibility to plants.

29. What are leucoplasts and where do they occur? (RWP. GI)

Ans: Leucoplasts are colourless plastids and store starch, proteins and lipids. They are present in the cells of those parts where food is stored.

30. Describe the functions of xylem and phloem tissues. (RWP. GII, LHR. GII, MLN. GII)

Ans: Xylem tissue is responsible for transport of water, while phloem tissue transport food in plants body.

31 Why endoplasmic reticulum is called rough and smooth endoplasmic reticulum? (RWP. GII, SGD. GII)

Ans: Rough Endoplasmic Reticulum (RER): Rough endoplasmic reticulum is so-named because of its rough appearance due to the numerous ribosomes that are attached to it.

Smooth Endoplasmic Reticulum (SER): Smooth endoplasmic reticulum lacks ribosomes, and have smooth surface.

32. What is the difference between primary cell wall and secondary cell wall? (LHR. GI, RWP. GII)

Ans: Primary wall: The outer layer of the plant cell wall is known as primary wall and cellulose is the most common chemical in it.

Secondary wall: Some plant cells, such as xylem cells, also have secondary walls on the inner side of the primary wall. It is much thicker and contains lignin and other chemicals.

33. Differentiate between Transmission Electron Microscope and Scanning Electron Microscope. (DGK. GI)

Ans: Transmission Electron Microscope (TEM): TEM is used to study the details of the internal cell structure. In TEM, electrons are transmitted through the specimen.

Scanning Electron Microscope (SEM): In SEM, electrons are reflected from the metal-coated surfaces. SEM is used to study the structure of cell surfaces.

34. Write down the function of cytoplasm. (DGK. GI)

Ans: The cytoplasm of the cell provides space for the proper functioning of the organelles. It also acts as the sites for various metabolic reactions for example glycolysis.

35. What is meant by thylakoids? (DGK. GI)

Ans: The internal wall of chloroplast give rise to sac like structures. This is called thylakoids.

36. Write a note on Skeletal muscles functions. (DGK. GII)

Ans: Structure: These composed of striated (striped) cells and contain many nuclei.

Location: These are found attached to bones.

Function: These are responsible for movements of bones. These muscles are voluntary in action.

37. What is Active Transport? (DGK. GII)

Ans: The movement of molecules or substance from their lower concentration to their higher concentration by the use of energy is called Active Transport.

38. Differentiate between magnification and Resolution. (BWP. GI, RWP. GI, SGD. GI)

Ans: Magnification: Magnification is the increase in the apparent size of an object and it is an important factor in microscopy.

Resolution: Resolution is the minimum distance at which two objects can be seen as separate objects. It is the measure of the clarity of an image.

39. What is meant by Cytoskeleton? (BWP. GII)

Ans: The cytoskeleton is a network of microfilaments and microtubules.

Microtubules are made of tubulin protein and are used by cells to hold their shape. They are also the major component of cilia and flagella while microfilaments are thinner and made up of action protein.

40. What are lysosomes? Give their function. (LHR. GI)

Ans: These are single membrane bound organelles. It contain strong digestive enzymes which break down the food particles and also waste materials.

41. What is the difference between apical meristems and lateral meristems? (LHR. GII)

Ans: Apical meristems occur in roots and stems. In this length of plant is increased as a result of division, while lateral meristems is occur is roots and ends of stems, It cause horizontal expansion of plants.

42. When and where was the first microscope made? (GRW. GI)

Ans: The first compound microscope was developed by Zacharias Janssen in Holland in 1595.

43. Differentiate between cell membrane and plasma membrane. (GRW. GI)

Ans: When we talk about all the membranes of a cell, we say them as cell membrane, while when we talk about only the outer membrane of cell, we say it as plasma membrane.

44. What is the difference between thylakoids and stroma? (FBD. GI)

Ans: Internal membrane of chloroplast contain sac filled with liquid these are called thylaukoids. While the liquid present in chloroplast is called stroma.

45. What are meristematic tissues? Write names of its two types. (FBD. GI)

Ans: The tissue which are made up of those cells which have ability to divide are called

meristematic tissues. These tissue have a large nucleus and thin wall.

Two main types of meristematic tissues are:

1. Apical meristems. 2. Lateral meristems.

46. What is meant by hypertonic and hypotonic solutions? (FBD. GI)

Ans: **Hypertonic solution:** The solution which contain large amount of solute is called hypertonic solution, while solution with lesser amount of solute is called hypotonic solution.

47. What is the difference between endocytosis and exocytosis? (FBD. GII)

Ans: The process of cellular ingestion of bulky materials by infolding of cell membrane is called endocytosis while exportion of bulky materials through cell membrane is known as exocytosis.

48 Name four types of epithelial tissues. (FBD. GII)

Ans:
1. Squamous epithelium
2. Cuboidal epithelium
3. Columnar epithelium
4. Ciliated columnar epithelium

49. What is meant by Supporting Tissues in Plant? (MLN. GI)

Ans: Those tissues which give support and flexibility to plants are called supporting tissues. e.g. collenchyma tissue and sclerenchyma tissue.

50. Describe the chemical composition of cell wall of Fungi and Prokaryotes. (MLN. GII)

Ans: Cell wall of fungi is made up of chitin while prokaryotic cell wall contain a chemical known as peptidoglycan.

51. What are Plastids? Name their kinds. (MLN. GI & GII)

Ans: Plastids are membrane bound organelles that are only found in plants and some photosynthetic protists.

Types of plastids: ☆ Chloroplast ☆ Chromoplast ☆ Leucoplast

52. Give the function of centriole. (SWL. GI)

Ans: Centrioles helps in formation of spindle fibre during cell division. In some cells they are also used to form cilia and flagella.

53. Write difference between hypotonic and isotonic solutions. (SWL. GII)

Ans: The solution which have relatively less amount of solute is called hypotonic, while solution having equal concentrations of solute is known as isotonic.

54. What is the role of phloem tissues in plants? (SWL. GII)

Ans: Phloem tissue is responsible for the conduction of dissolved organic matter food in whole plant body.

55. Describe turgor pressure and turgor. (SGD. GI)

Ans: The outward pressure on cell wall exerted by internal water is known as turgor pressure, and the phenomenon is called turgor.

56. Write important points of cell Theory. (SGD. GII, RWP. GII)

Ans: All organisms are made up of one or more cells.

1. Cell are the smallest things, the basic unit of organizations of all organism.
2. Cells arise only by the divisions in previously existing cells.

57. Write one difference between prokaryotic and eukaryotic organisms. (DGK. GI)

Ans: The organism which have a proper nucleus in their cells are called eukaryotic organisms, while which do not have a proper nucleus in their cells are called prokaryotic organism.

58. What is meant by hypertonic solution? (DGK. GI)

Ans: The solution with greater amount of solute is called hypertonic solution.

59. Define secondary growth. (DGK. GI)

Ans: Lateral meristems are located on lateral side of root and shoot, by dividing. They are responsible for growth. This is called secondary growth.

60. Define Prokaryotic cell. (DGK. GII)

Ans: The cell in which proper nucleus is not present is called prokaryotic cell.

61. What are the functions of leucoplasts and chromoplasts? (DGK. GII)

Ans: Leucoplasts are used to store starch, protein and lipids.
Chromoplasts give colors to parts of plants, thus helpful in pollination.

62. How does Electron Microscope works? (BWP. GI)

Ans: Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or photographic film.

63. Write a note on structure of Mitochondria. (BWP. GI)

Ans: Mitochondria are double membrane bounded structure found only in eukaryotes, outer membrane of mitochondria is smooth, while inner membrane forms infolding called cristae.

64. What is meant by Passive Diffusion? (BWP. GII)

Ans: Movement of molecules from area of higher concentration to lower concentration is called passive diffusion, because in this process energy is not used.

65. Why cell membrane is called semipermeable membrane? (BWP. GII)

Ans: Cell membrane is called semi permeable membrane because it only allow selective substances to pass through it while other are blocked. i.e only specific size molecules can pass through it.

Major Concepts:

Q.1. Why cell division is necessary for the continuation (تسلسل) of life?

Ans: The most important characteristic of life is reproduction (عمل تولید). Reproduction occurs at different levels of organization. Parts of cell such as chromosomes produce new chromosomes, cells produce new cells and individuals produce new offspring like themselves. Rudolf Virchow proposed an important biological principle i.e. all cells come from cell. This principle tells us that the continuation of life, including all aspects of reproduction is based on the reproduction of cells. Reproduction of cells is called cell division and it is a part of the whole life of a cell.

5.1 CELL CYCLE

Q.2. What is the cell cycle and what are its main phases (مراحل)?

Ans: ***Definition:*** "The cell cycle is the series of events from the time a cell is produced until it completes mitosis and produces new cells."

Major Phases:

The cell cycle consists of two major phases:

1. Mitotic Phase:

This phase is a relatively short period of cell cycle. It alternates (تبدیل ہوتا ہے) with much longer interphase, where cell prepares it self for division.

2. Interphase:

Interphase is the time when a cell's metabolic activity is very high, as it performs its various functions.

Phases of Interphase:

Interphase is divided into the three phases.

1. G1 (first gap)
2. S (synthesis)
3. G2 (second gap)

1. G1 phase:

G1 phase is the first phase of cell cycle in which the cell increases its supply of proteins, increases the number of its organelles (such as mitochondria, ribosomes), and grows in size. This phase is also marked by the synthesis of various enzymes that are required in next phase i.e. S phase for the duplication (دوگنا ہونا) of chromosomes.

2. S phase:

In this phase, cell duplicates its chromosomes. As a result each chromosome consists of two sister chromatids.

3. G2 phase:

In the G2 phase, proteins for the production of spindle fibers are synthesized.

Inhibition of protein synthesis during G2 phase prevents the cell from undergoing mitosis.

M Phase:

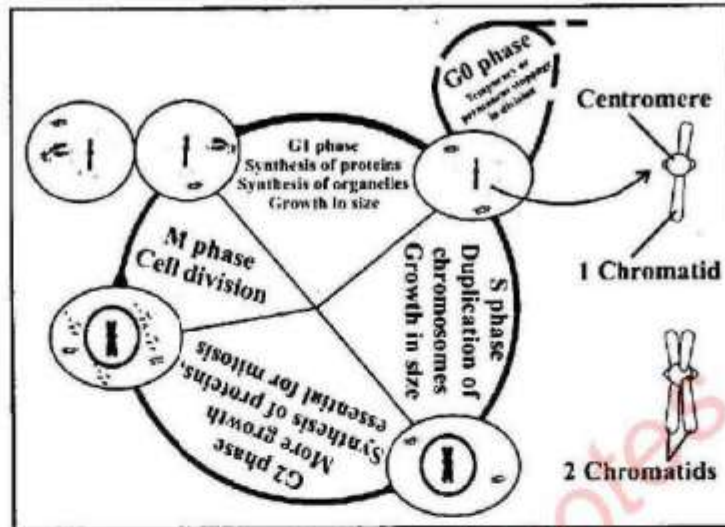
After the G2 phase of interphase, cell enters the division phase i.e. M phase.

- It is characterized by mitosis in which cell divides into the two daughter cells.

G0 phase:

Cells that have temporarily (عارضی طور پر) or permanently (مستقل طور پر) stopped dividing are said to have entered a state of quiescence (بے حسی) called G0 phase.

In multicellular eukaryotes, cells enter G0 phase from G1 and stop dividing.
Epithelial cells do not enter G0 phase and continue to divide throughout the life (ساری زندگی).

- Some cells remain in G0 for indefinite (غیر معینہ) period e.g. neurons.
- Some cells enter G0 phase semi-permanently e.g. some cells of liver and kidney.
- Many cell do not enter G0 and continue to divide throughout an organisms's life. e.g. epithelial cells.

The eukaryotic cell cycle

The events of cell cycle are ordered (ترتیب دار) and directional i.e. each event occurs in a sequential (تسلسل کے ساتھ) fashion and it is impossible to "reverse" (اُلٹنا) the cycle.

Q.3. The S-phase of interphase is important and a cell can never divide without it. Justify.

Ans: Duplication of chromosomes takes place in S phase of interphase. The DNA molecule of each chromosome is copied, and new protein molecules are attached. The result is that each chromosome consists of two sister chromatids, which contain identical genes.

In the absence of S phase, daughter cells cannot get equal amount of genetic material and hence cannot survive.

5.2 MITOSIS

Q.4. Define mitosis. Also detail the events in different phases of mitosis. Draw labelled diagrams where necessary.

Ans: Our body consists of about 200 trillion (200 کھرب) cells, all of them derived (اخذ کیے گئے) from millions of mitotic cell divisions in a zygote.

Mitosis:

After the G2 phase of interphase, the cell enters the division phase i.e. M phase. It is characterized by mitosis, in which the cell divides into the two daughter cells.

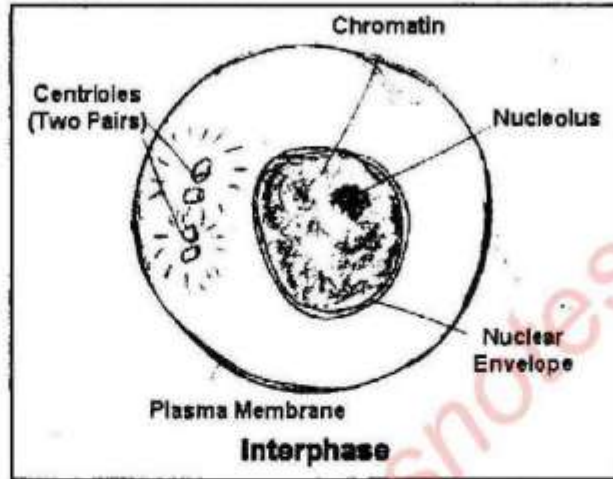
Mitosis is the type of cell division in which a cell divides into two genetically identical (ایک جیسے) daughter cells.

Mitosis occurs only in eukaryotic cells. In multicellular organisms, the somatic (جسمانی) cells undergo mitosis.

Prokaryotic cells undergo a process similar to mitosis called binary (دو جزوں پر مشتمل)

fission (انشقاق پذیری) but they cannot be properly said to undergo.

Prokaryotes cannot do proper mitosis because they lack a nucleus and only have a single chromosome with no centromere.

Interphase

Phases of Mitosis:

Phases of mitosis were first detailed by A German biologist, **Walther Flemming** in 1880's. He observed that the nucleus of a dividing cell (تقسیم ہونے والا سیل) passes through a series of changes which he called mitosis.

Mitosis is complex and highly regulated.

The sequence of events is divided into two major phases:

Karyokinesis: The division of the nucleus (مرکزہ) is known as karyokinesis.

Cytokinesis: The division of the cytoplasm is known as cytokinesis.

A. KARYOKINESIS:

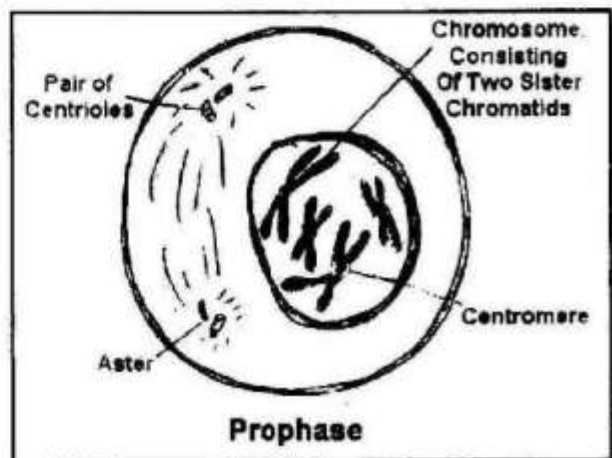
Karyokinesis is further divided into four phases:

i. Prophase *ii.* Metaphase *iii.* Anaphase *iv.* Telophase

i. Prophase:

(Pro=before, phase=appearance)

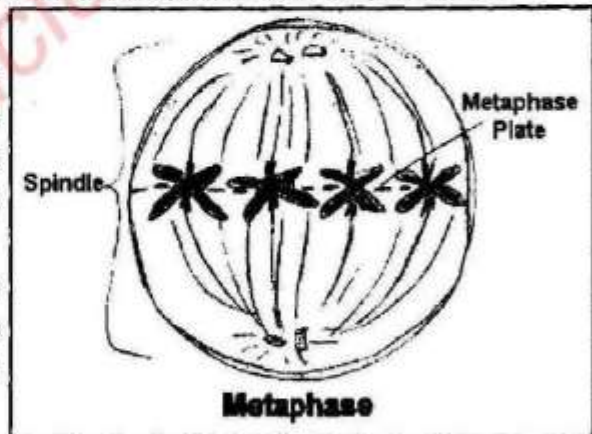
1. In prophase, chromatin (a loose thread-like (دھاگے نما) form of genetic material) condenses into chromosomes. Since the genetic material has already been duplicated earlier in S phase, each chromosome has kinetochore at the centromere. A kinetochore is a complex protein structure that is the point where spindle fibers (تکلا ریشے) attach.

Prophase

2. Two centrioles, collectively called a centrosome, are present near the nucleus. Each centriole duplicates to make two daughter centrosomes.
3. Both centrosomes migrate (جگہ تبدیل کرتے ہیں) to opposite poles of the cell during the formation of mitotic spindle. Here, they give rise to microtubules by joining tubulin proteins present in cytoplasm. The microtubules thus formed are called spindle fibres.
4. Complete set of spindle fibres is known as mitotic spindle.
5. The nucleolus and the nuclear envelope have degraded, and spindle fibres have invaded (جگہ لے لی ہے) the central space.
6. In plant cells with large vacuoles, the nucleus has to migrate into the centre of the cell before prophase.
7. The cells of plants lack centrioles. Instead (بجائے اس کے), spindle fibres are formed by the aggregation (مجموعہ) of tubulin proteins on the surface of the nuclear envelope during prophase.

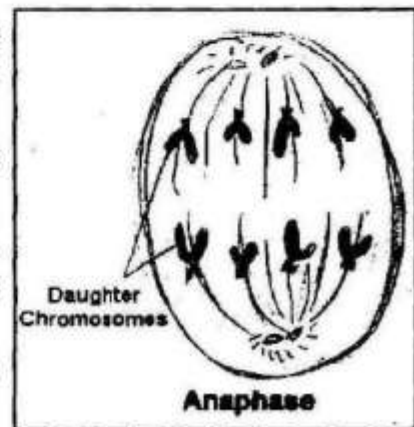
*ii. **Metaphase:***

(Meta = after, phase = appearance)

1. When the spindle fibres grows to sufficient (کافی) length, some of the spindle fibres, known as kinetochore fibres, attach with the kinetochores of chromosomes.
2. When two kinetochore fibers from opposite poles (مخالف کناروں سے) attach with each chromosome, the chromosomes arrange themselves along the equator of the cell (خلیہ کا درمیانی خط) forming a metaphase plate.
3. A number of other fibres (non-kinetochore) from the opposite centrosomes attach with each other.

Metaphase

*iii. **Anaphase:***

(Ana = upper, phase=appearance)

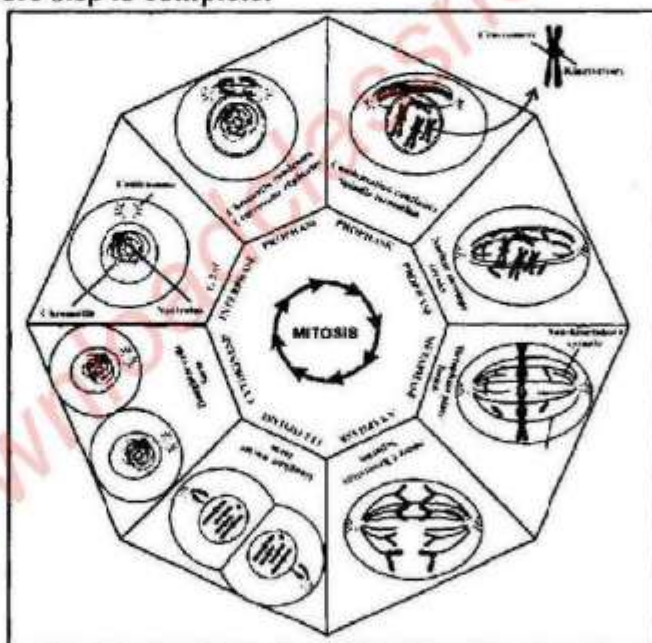
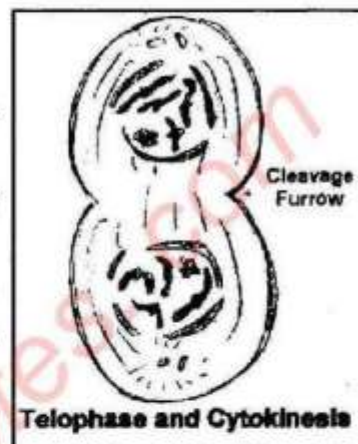
1. Kinetochore spindle fibers, connected to the kinetochore of chromosome, starts to pull towards the originating (ابتدا کرنے والے) centrosomes.
2. The pulling force divides the chromosome's sister chromatids and they separate (علیحدہ ہو جاتے ہیں).
3. Sister chromatids are now sisters chromosomes, and they are pulled apart toward the respective centrosomes.
4. The other spindle fibres (non kinetochore) also elongate.

Anaphase

5. At the end of anaphase, cell is now successful in separating identical copies of chromosomes into two groups, at opposite poles.

iv. ***Telophase:***

(Telo = end, phase=appearance)

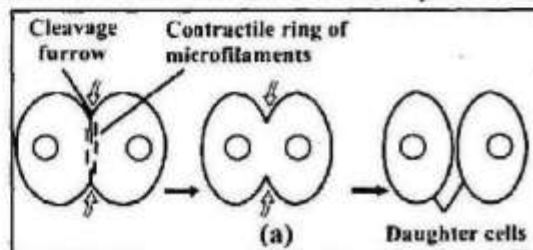
1. This phase is also called the reversal (الٹ) of prophase.
2. A nuclear envelope forms around each set of separated chromosomes.
3. Both sets of chromosomes, now surrounded by (گھرے ہوئے) new nuclear envelopes, unfold back into chromatin.
4. Nuclear division is completed. But the cell division has yet one more step to complete.

Telophase and Cytokinesis

Stages in mitosis

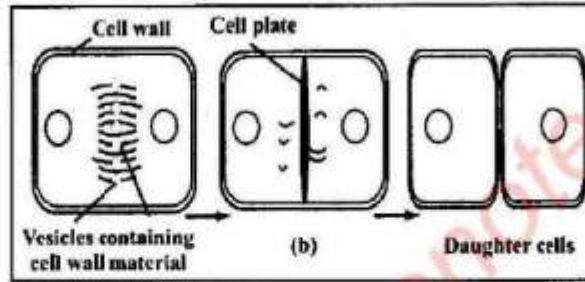
B. CYTOKINESIS:

Cytokinesis is the division of the cytoplasm. It is different in animal and plant cells.

Cytokinesis in animal cell:

In animal cells, cytokinesis occurs by a process known as cleavage (شگاف). A cleavage furrow (نالی) develops where the metaphase plate used to be. The furrow deepens and eventually (آخرکار) pinches the parent cell into two daughter cells.

Cytokinesis in animal cell

Cytokinesis in plant cells:

Cytokinesis in **plant cells** occurs differently. Vesicles derived from the Golgi apparatus move to the middle of the cell and fuse to form a membrane-bounded (جھلی سے گھری ہوئی) disc called the **cell plate** or **phragmoplast**. The plate grows outward (باہر کی طرف) and more vesicles fuse with it. Finally, the membranes of the cell plate fuse with the plasma membrane and its contents join the parental cell wall. The result is two daughter cells, each bounded by its own plasma membrane and cell wall.

Cytokinesis in plant cell

5.2.1 SIGNIFICANCE OF MITOSIS

Q.5. How is mitosis significant?

Ans: Mitosis helps in the maintenance of chromosomal set i.e. each daughter cell receives chromosomes that are alike in composition and equal in number (تعداد میں) to the chromosomes of parent cell.

Mitosis is helpful in following ways:

1. ***Development and growth:***

Mitosis increases the number of cells and this is the basis (بنیاد) of development from a single cell zygote to the multicellular body and the growth.

2. ***Cell replacement:***

In some parts of body e.g. skin and digestine tract, cells are constantly (متواتر) sloughed off (اُتر جاتے ہیں) and replaced by new ones.

- New cells are formed by mitosis and so are exact copies of the cells being replaced.
- Red blood cells have short life span (مختصر زندگی کا عرصہ) (about 4 months) and new red blood cells are formed by mitosis.

3. ***Regeneration (دوبارہ پیدا کرنا):***

Some organisms can regenerate parts of their bodies. The production of new cells is achieved by mitosis.

Example: Sea star regenerates its lost arm through mitosis.

4. ***Asexual reproduction***

Some organisms produce genetically similar offspring, through asexual reproduction. Mitosis is a mean of (طریقہ) asexual reproduction.

Example: Hydra reproduces asexually by budding (کلی کی صورت میں تشکیل پانا). The cells at the surface of Hydra undergo mitosis and form a mass called bud. Mitosis continues in the cells of the bud and it grows into a new individual.

The same division happens during asexual reproduction (vegetative propagation) in plants.

Q.6 What errors can take place in mitosis?

Ans: ERRORS IN MITOSIS:

Cancer: Errors in the control of mitosis may cause cancer (سرطان). All cells have genes that control the timing and number of mitosis.

Tumours: (رسولیاں)

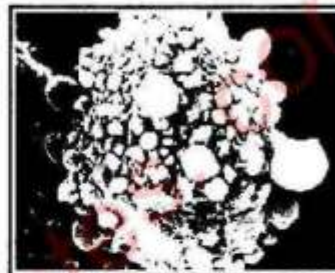
Sometimes mutations (جینیاتی تبدیلیاں) occur in such genes and cells continue to divide. It results in growths of abnormal cells called **tumours**.

Benign and malignant:

As long as these tumours remain in their original location, they are called **benign tumours**.

But if they invade other tissues, they are called malignant (cancerous) tumours and their cells are called cancer cells.

Metastasis

Malignant tumours can send the cancer cells to other parts in the body where new tumours may form. This phenomenon is called metastasis (spreading of diseases).

PRACTICAL WORK

Q.7. Study different stages of mitosis in root tip squashes.

Ans: ***Preparation of root tip squashes and study of the stages of mitosis:***

The number of cells within an organism increases by mitosis and this is the basis of growth in multicellular organisms.

Problem: While observing the cells from the tip of an onion root (پیاز کی جڑ), can we identify cell in different stages of mitosis. (You may use your textbook to help you identify the stages of mitosis.)

Apparatus required: Microscope (خوردبین), slides, fresh grown onion root tip, 5-10ml distilled water, 5ml 6M HCl, 1 ml Feulgen reagent in a vial, dropper pipette, beaker, and a pencil with eraser or small cork to squash the slide, toothpicks.

Background information:

- Growth in an organism is carefully controlled by regulating the cell cycle.
- In plants, the roots continue to grow.
- The tips of roots are good for studying the cell cycle because at any given time, we can find cells that are undergoing mitosis.

- Slicing (ٹکڑے کرنا) the onion root captures many cells in different phases of the cell cycle.

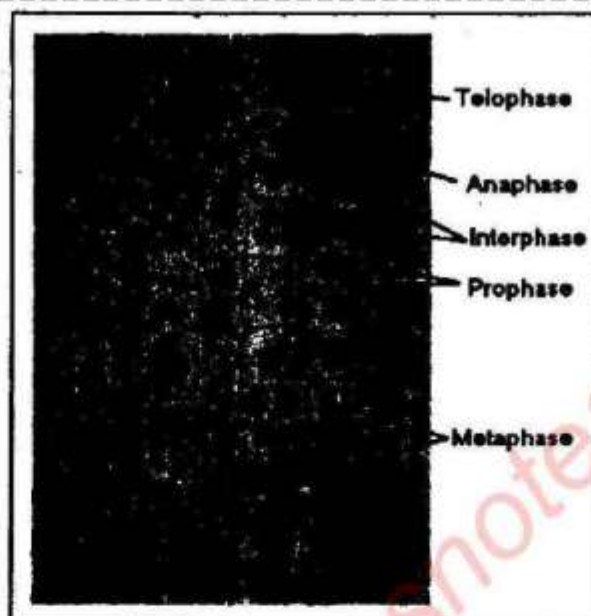
Procedure:

1. Take an onion and place it in a cup of water so that only the root portion (جڑ والا حصہ) is under water. (To do this, push toothpicks into the side of the onion which extend outward and hold it on the rim of the cup. New roots should grow within two days.)
2. Preheat about 10 ml of Hydrochloric acid in a small beaker to 60°C using a waterbath.
3. Using scissors (قینچی) remove the last 2 mm from several growing root tips. Place them in the preheated acid and return to the waterbath for 4-5 minutes.
4. Gently transfer each root tip to a clean microscope slide containing water drop.
5. Gently blot dry with a piece of soft tissue. It is important to remove as much water as possible.
6. Using a dissection needle, thoroughly chop up (کاٹ لیں) the root tip and spread over an area equivalent to the size of a 01 rupee coin. (Alternatively (متبادل کے طور پر) you can place another microscope slide at right angles to the original slide to form a cross, and squash the tip between the two slides.
7. Place a coverslip over the broken tissue trying not to get air bubbles (بلبلے) under it.
8. Press down firmly onto the coverslip with a small cork or pencil eraser to spread the cells in a very thin layer.
9. For staining, remove the coverslip and add one drop of the stain to the macerated (بھگو کر نرم کرنا) root tip and immediately cover with a coverslip.
10. Place the slide on the compound microscope.
11. Locate growth zone, which is just above the root cap at the very end of the tip.
12. Focus in on low power, and then switch to medium or high power.
13. Find textbook diagrams of the four stages of mitosis and use them to help you identify the stages on the microscope slide.

Observations: Each slide shows a number of cells in different stages and the darkly stained areas can be easily distinguished.

Evaluation:

i. **Copy this table onto a paper. You can enter data in this table as you go along, or at the end of the activity.**

	Prophase	Metaphase	Anaphase	Telophase	Total
Number of cells	6	3	3	2	14

Cells in different stages of cell cycle

5.3 MEIOSIS

Q.8. Define meiosis.

Ans: Meiosis is the process by which one diploid (2n) eukaryotic cell divides to generate four haploid (1n) daughter cells. Diploid means the cells in which chromosomes are in pairs (جوڑوں میں) (homologous pairs) while haploid means the cells with half the number of chromosomes i.e. chromosomes are not in the form of pairs.

History of word meiosis:

The word meiosis comes from Greek (یونانی) word "meioun", meaning "to make smaller". Since it results in a reduction (کمی) in chromosome number.

5.3.1 PHASES OF MEIOSIS

Q.9. Describe different events that occur during the phases of meiosis I and meiosis II.

Ans: Meiosis was discovered (دریافت کیا گیا) and described (بیان کیا گیا) for the first time by a German biologist **Oscar Hertwig** in 1876.

The preparatory steps of meiosis are identical (ویسی) to the interphase of mitosis. Interphase is divided into the same three phases i.e. G1, S phase, and G2. Interphase is followed by meiosis I and meiosis II.

PHASES OF MEIOSIS I:

The karyokinesis of meiosis I is subdivided (تقسیم در تقسیم کیا گیا ہے) into:

1. Prophase I 2. Metaphase I 3. Anaphase I 4. Telophase I

1. *Prophase I:*

Prophase I is the longest phase in meiosis. During this stage, chromatin condenses (سکڑتا ہے) into chromosomes.

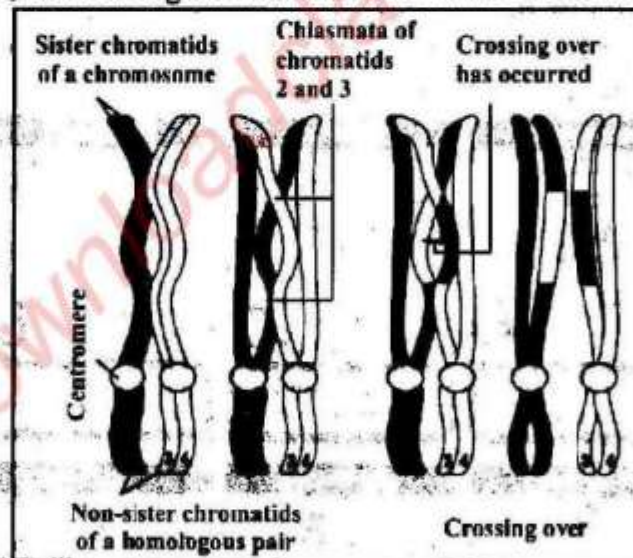
The homologous chromosomes line up with each other and form pairs by the process of synapsis. Each pair of homologous chromosomes are said to be ***bivalent*** (دو گرتی).

Tetrad:

Each bivalent has four chromatids, so it may also called a tetrad. The two non-sister chromatids of homologous chromosomes join each other at certain points (مخصوص نکات پر جڑ جاتے ہیں) along their length. These points of attachment (ملاپ) are called chiasmata.

In the next stage, the non-sister chromatids of homologous chromosomes exchange their segments and the phenomenon is known as **crossing over**. In 1911 the American geneticist **Thomas Hunt Morgan** observed the phenomenon of crossing over in the fruit fly (پھلوں کی مکھی) *Drosophila melanogaster*.

Exchange of segments:

The exchange of segments results in a recombination (دوبارہ ملاپ) of genetic information. After crossing over, the homologous chromosomes remain as a bivalent.

Chromosomes condense further, the nucleoli disappear, and the nuclear envelope disintegrates. Centrioles, which were duplicated during interphase, migrate to the two poles and form spindle fibres. The kinetochore spindle fibres attach with kinetochores of chromosomes. While the non-kinetochore spindle fibres from both sides interact (جوابی عمل کرنا) with each other. There are two kinetochores on each tetrad, one for each kinetochore spindle fibre.

2. *Metaphase I:*

The pairs of homologous chromosomes align (سیدھ میں ہو جاتے ہیں) along an equatorial plane forming the metaphase plate.

3. ***Anaphase I:***

Kinetochore spindle fibres shorten (چھوٹے ہو جاتے ہیں). It results in pulling apart the chromosomes of each pair. Since one chromosome is pulled toward one pole, two haploid sets are formed. Each chromosome still contains a pair of sister chromatids.

4. ***Telophase I:***

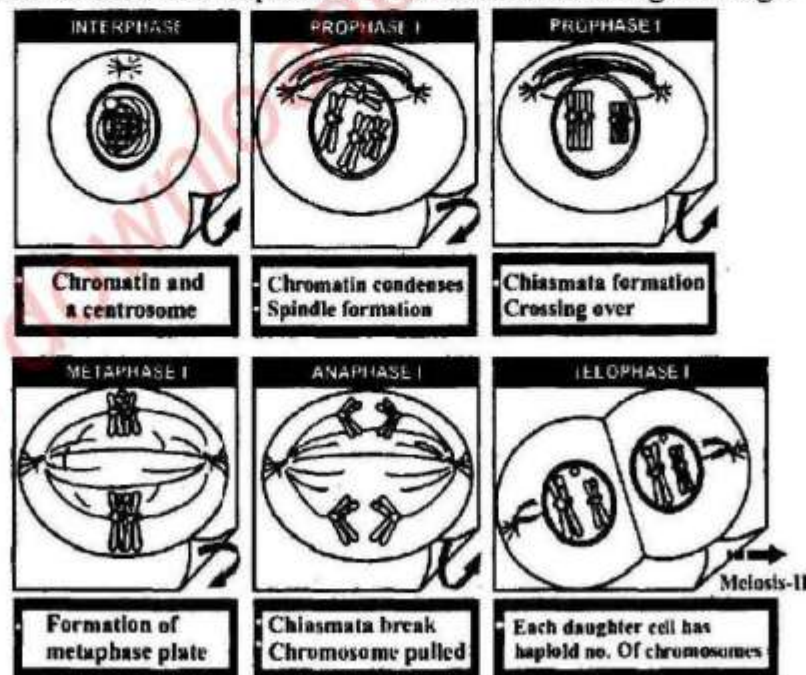
Chromosomes arrive at the poles. Each pole now has half the number of chromosomes but each chromosome still consists of two chromatids. The spindle network disappears (غائب ہو جاتا ہے), and nuclear envelope is formed around each haploid set. The chromosomes uncoil back into chromatin.

Cytokinesis:

Cytokinesis, the pinching of the cell membrane in animal cells or the formation of the cell wall in plant cells, occurs and the creation of two haploid daughter cells is completed.

Interkinesis or Interphase II:

After meiosis I both haploid daughter cells enter a period of rest (آرام) known as interkinesis or interphase II.

The interphase II is different from the interphase of mitosis and meiosis I. There is no S-phase and so there is no duplication of chromosomes during this stage.

Stage in Meiosis-I

PHASES OF MEIOSIS II:

It is the second part of meiosis and is similar (مشابہ) to mitosis. It is subdivided into prophase II, metaphase II, anaphase II, and telophase II.

Prophase II:

Prophase II takes much less time as compared to prophase I. In this prophase, nucleoli and the nuclear envelope disappear and the chromatin condenses. Centrioles move to the polar regions and make spindle fibres.

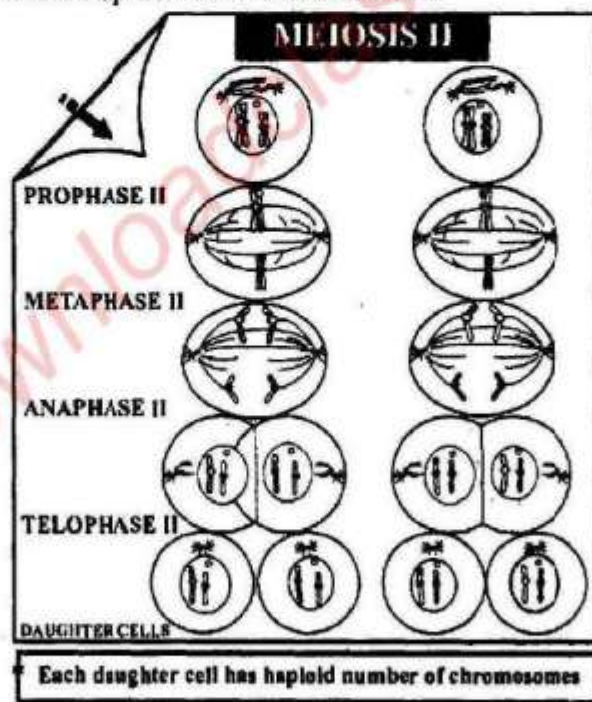
Metaphase II:

In metaphase II, the chromosomes attach with the kinetochore spindle fibers and align at the equator of the cell. This is followed by anaphase II.

Anaphase II:

In anaphase II, where the centromeres are cleaved (کٹ جانا) and sister chromatids are pulled apart (علیحدہ). The sister chromatids are now called sister chromosomes, and they are pulled toward opposing poles.

Telophase II:

The telophase II is marked with uncoiling of chromosomes into chromatin. Nuclear envelopes reform; cleavage or cell wall formation eventually produces a total of 4 daughter cells, each with a haploid set of chromosomes.

Stages in Meiosis-II

Q.10. Describe the significance of meiosis.

Ans: SIGNIFICANCE OF MEIOSIS:

In 1890, a German biologist, August Weismann, noted that meiosis was necessary, not only to maintain the number of chromosomes in the next generation but also to produce variations (تضاد) in next generation (نسل).

Maintenance of the chromosome number in next generation:

Meiosis is essential (ضروری) for sexual reproduction. In humans, diploid gamete-mother cells or germ line cells undergo meiosis to produce haploid gametes, male and female gametes unite to form diploid zygote, which undergoes repeated (بار بار) mitosis and develops into a new diploid human.

Significance of meiosis in maintaining chromosome number constant

Production of gametes in fungi and protozoan:

Many haploid fungi and protozoans produce haploid gametes through mitosis.

Alternation of generations (نسلوں کا بدلنا) :

Plants'life cycle shows alternation of generations. The cells of the diploid sporophyte generation undergo meiosis to produce haploid spores, which grow into haploid gametophyte generations. Gametophyte generation produces haploid gametes through mitosis. The gametes combine to produce diploid zygote. Zygote undergoes repeated mitosis to become diploid sporophyte.

Production of variations in next generations:

The chromosome pairs of each parent undergo crossing over during meiosis. So daughter cells i.e. gametes have genetic variations. When gametes fuse and form zygote, its genetic make is different from both parents. Thus meiosis allows a species to bring variations in next generation. Beneficial (فائدہ مند) variations help organisms to adapt to (ڈھل جانا) the changes in environment.

Q.11. Describe some errors in meiosis.

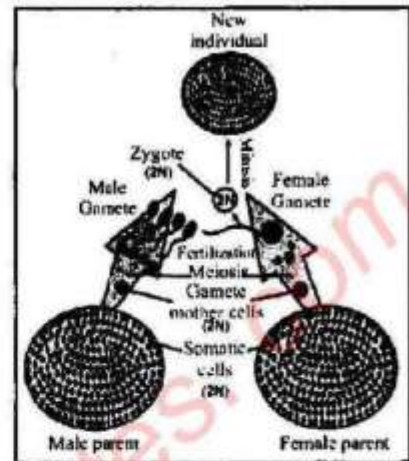
Ans: ERRORS IN MEIOSIS:

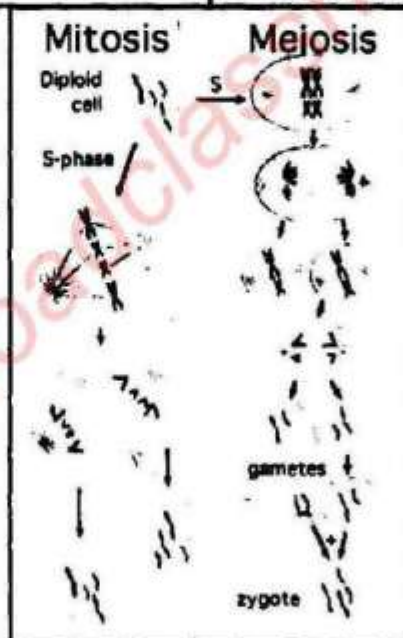
Non-Disjunction (غیر تفریق): Many errors can occur during meiosis. The most common (بہت عام) is non-disjunction. The normal separation of chromosomes or sister chromatids in meiosis is termed as disjunction. When the separation is not normal, it is called non-disjunction. This results in the production of gametes which have either more or less than the normal number (معمول کے مطابق) of chromosomes.

If such abnormal gamete fuses with a normal gamete, it results abnormal chromosome number in next generation, for example 47 or 45 chromosomes in humans.

Q.12. Contrast mitosis and meiosis, emphasizing the events that lead to different outcomes.

Ans: COMPARISON BETWEEN MITOSIS AND MEIOSIS:

Meiosis II is similar to mitosis while meiosis I makes the actual (اصلی) difference between these two cell divisions.

Following table shows the main difference.

Mitosis	Meiosis
1. Homologous chromosomes do not form pairs. There is no crossing over.	1. Pairing of chromosomes Crossing over between homologous chromosomes.
2. Single chromosomes align (سیدھ میں) to form metaphase plate.	2. Homologous pairs align to form metaphase plate.
3. Chromosomes break and individual chromatids are pulled towards poles.	3. Individual chromosomes are pulled towards poles.
4. Daughter nuclei contain diploid number of chromosomes.	4. Daughter nuclei contain haploid number of chromosomes.
5. Each chromosome has single chromatid.	5. Each chromosome has two chromatids.

Mitosis and Meiosis; A comparison (تقابل)

PRACTICAL WORK

Q.13. Observe different stages of mitosis and meiosis.

Ans: Observation of various stages of mitosis and meiosis by slides, models and charts.

Mitosis and meiosis are sequential events (ترتیب وار) in which a parent cell divides.

Problem: Can we organize the stage of mitosis or meiosis by finding some hints in the slide or diagram?

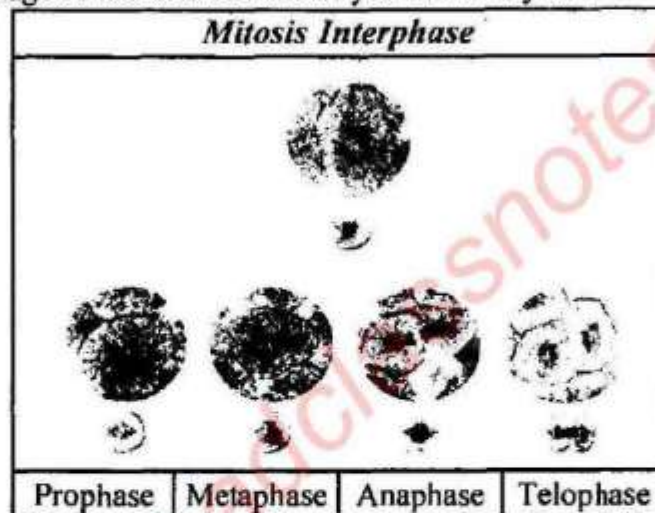
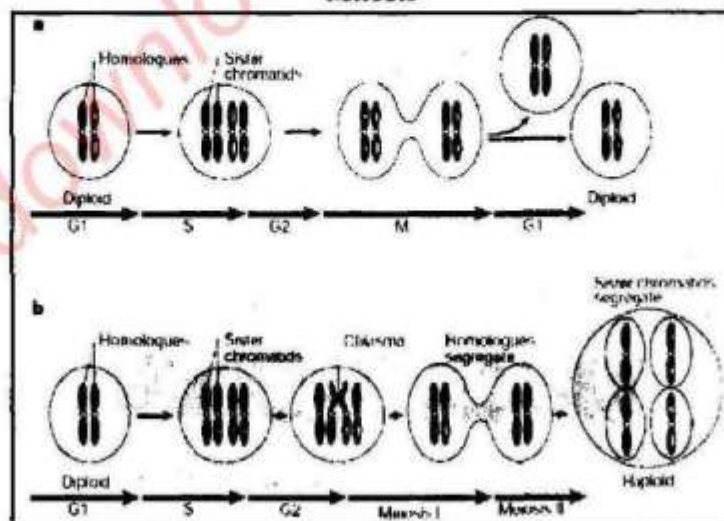
Background information:

- We should have a comprehensive (مکمل) knowledge of the events that occur in each

stage of mitosis and meiosis.

Procedure (طریقہ):

1. Observe the given material (slide, model or chart). Slide must be observed under microscope.
2. Draw illustration (خاکہ) on your notebook and try to label different components.
3. Point out important features (خصوصیات) of your illustration and recall the events that occur during mitosis and meiosis.
4. Indicate the stage of cell division which you think may be.

Mitosis Interphase			
Prophase	Metaphase	Anaphase	Telophase

Mitosis

Meiosis

Evaluation:

1. If you found that the given specimen was taken from an animal tissue and the cells were undergoing meiosis, what would be the daughter cell?

Ans. Daughter cells are sperms or eggs.

ii. **What is the main feature of prophase- I of meiosis, which differentiates it from the prophase of mitosis?**

Ans. Prophase - I of meiosis was homologous chromosomes.

iii. **Chromosomes are only visible (دکھائی دیتے ہیں) during cell division and not visible during interphase. Why?**

Ans. In the inter-phase chromosomes are present (موجود ہوتے ہیں) in the form of mitotic apparatus and not easily visible.

5.4 APOPTOSIS AND NECROSIS

Q.14. Describe apoptosis.

Ans: Apoptosis is a phenomena of cell death.

Apoptosis:

Apoptosis is one of the main types of programmed (پروگرام کیا گیا) cell death.

Events (مراحل) of Apoptosis:

Following is the series of events in apoptosis.

1. **Cell shrinks (سکڑتا ہے) and becomes rounded due to the breakdown of the cytoskeleton by enzymes.**
2. Its chromatin undergoes condensation and nuclear envelope breaks.
3. The nucleus spreads into several (بہت سے) discrete (نمایاں) chromatin bodies.
4. The cell membrane makes irregular buds known **as blebs,** through which the cellular components are discharged.
5. The blebs break off from the cell and are now called apoptotic bodies, which are then phagocytosed (باہر کر دینا) by the other cells.

Significance:

- Apoptosis can occur when a cell is damaged, or undergoes stress (سخت) conditions.
- Apoptosis removes the damaged cell, preventing it from getting further nutrients, or to prevent the spread of infections.
- Apoptosis also gives advantages (فائدے) during development.

Example:

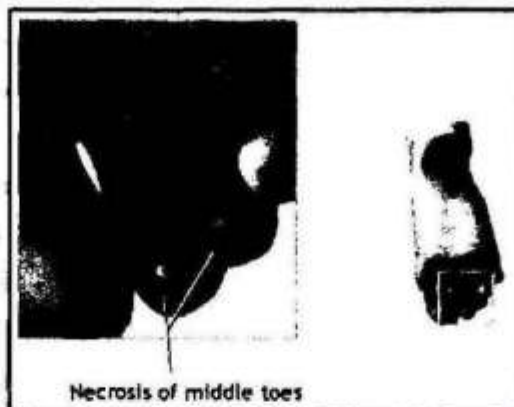
During the formation of fingers, the cells between them under go apoptosis and the digits separate.

Q.15. Describe the causes and patterns of necrosis.

Ans: NECROSIS:

Necrosis is the accidental death (حادثاتی موت) of cells and living tissues. Necrosis is less sequential than apoptosis.

Causes: There are many causes of necrosis including injury (زخم), infection, cancer etc.

Necrosis of middle toes

During necrosis there is a release of special enzymes from the lysosomes (جھلی میں بند تھیلی خامروں کا حامل). The lysosomal enzymes break cellular components and may also be released outside cell to break other surrounding (اردگرد والے) cells. Cells that die by necrosis may also release harmful (نقصان دہ) chemicals that damage other cells.

Pattern of Necrosis:

Necrosis may occur when a cell is given hypoxic (with less oxygen) environments (ماحول).

Review Questions

MULTIPLE CHOICE:

1. In which stage of the cell cycle each chromosome is duplicated and so it consists of two chromatids?
(a) G1 (b) S (c) M (d) G2

2. If you observe a cell like this one, what phase of mitosis is it?
(a) Anaphase (b) Telophase (c) Metaphase (d) Prophase

3. During which phase of mitosis spindles are formed?
(a) G2 (b) Interphase (c) Prophase (d) Metaphase

4. In which stage of the cell cycle, the cell is preparing enzymes for chromosome duplication?
(a) G1 (b) G2 (c) S (d) M

5. Which of the following stage of cell division is very different for animal and plant cells?
(a) Metaphase (b) Anaphase (c) Telophase (d) Cytokinesis

6. Prior to cell division, each chromosome replicates or duplicates its genetic material. The products are connected by a centromere and are called:
(a) Sister chromosomes (b) Homologous chromosomes
(c) Non-sister chromatids (d) Sister chromatids

7. The process of mitosis ensures that:
(a) Each new cell is genetically different from its parent

(b) Each new cell receives the proper number of chromosomes
(c) Cells will divide at the appropriate time
(d) Chromosomes duplicate without errors.

8. Cytokinesis in a plant cell is characterized by:
(a) The equal division of homologous chromosomes.
(b) A pinching of the cell membrane to divide the cell
(c) The formation of a cell plate in the cytoplasm
(d) The movement of the chromosomes from the metaphase plate

9. Which of the following is unique to mitosis and not a part of meiosis I?
(a) Homologous chromosomes pair forming bivalents
(b) Homologous chromosomes cross over
(c) Chromosome pairs are broken during anaphase
(d) Chromatids separate during anaphase

10. Which event distinguishes meiosis from mitosis?
(a) Condensation of chromosomes (b) Loss of the nuclear membrane
(c) Formation of metaphase plate (d) Pairing of homologous chromosomes

11. In which stage of the cell cycle most cells spend their lives?
(a) Prophase (b) Metaphase (c) Interphase (d) Telophase

12. Which of the following distinguishes meiosis from mitosis?
(a) The chromosome number is reduced
(b) Chromosomes undergo crossing over.
(c) The daughter cells are genetically different from the parent cell.
(d) All of the above

13. For mitosis, the chromosomes of cell duplicate during interphase. When do the chromosomes duplicate for meiosis?
(a) Before meiosis I (b) Before meiosis II
(c) During meiosis I (d) Do not duplicate

14. Find the correct statement.
(a) Homologous chromosome form pairs during mitosis
(b) Chromosomes do not duplicate in the interphase preceding meiosis I
(c) Homologous chromosomes form pairs during meiosis but not mitosis
(d) Spindles are not required during meiosis

15. What reason would you suggest for the fact that the total DNA content of each daughter cell is reduced during meiosis?
(a) Chromosomes do not duplicate during the interphase before meiosis I
(b) Chromosomes do not duplicate between meiosis I and II
(c) Half of the chromosomes from each gamete are broken
(d) Sister chromatids separate during anaphase of meiosis I

Ans: **1.** S **2.** Anaphase **3.** Prophase **4.** G1
5. Cytokinesis **6.** Sister chromatids
7. Each new cell receives the proper number of chromosomes
8. The formation of a cell plate in the cytoplasm
9. Chromatids separate during anaphase
10. Pairing of homologous chromosomes **11.** Interphase
12. All of the above **13.** During meiosis I
14. Homologous chromosomes form pairs during meiosis but not mitosis
15. Sister chromatids separate during anaphase of meiosis I

UNDERSTANDING THE CONCEPTS

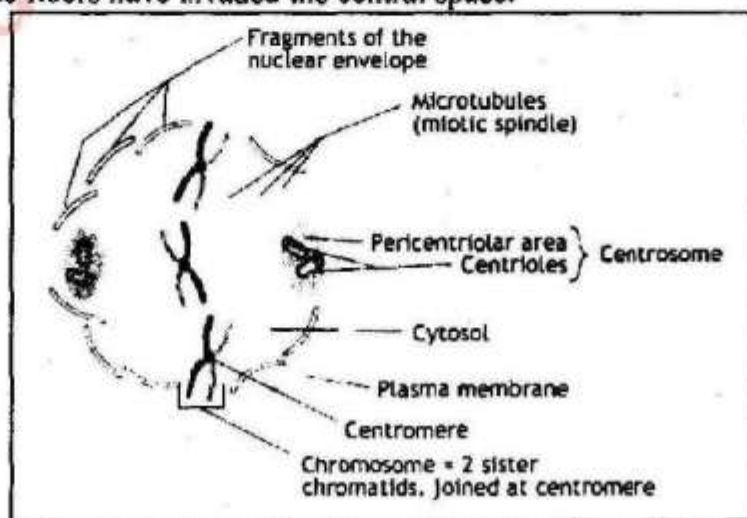
1. What is the cell cycle and what are its main phases?

Ans: Refer to Q.No.2 for answer.

2. The S-phase of interphase is important and a cell can never divide without it. Justify.

Ans: Refer to Q.No.3 for answer.

3. How would you state the events of prophase of mitosis?

Ans: Close to the nucleus are two centrioles, collectively called a centrosome. Each centriole replicates and thus two daughter centrosomes are formed. Each daughter centrosome acts as coordinating center for the cell's microtubules. The two centrosomes give rise to microtubules by polymerizing joining monomers to form polymers) the tubulin proteins present in the cytoplasm. The microtubules thus formed are called spindle fibers, and the complete set of the spindle fibers is known mitotic spindle. During the formation of mitotic spindle, the centrosomes migrate to opposite side of the nucleus. The nucleus and the nuclear envelope have degraded, and spindle fibers have invaded the central space.

In highly vacuolated plant cells, the nucleus has to migrate into the center of the cell before prophase. The cells of plants lack centrioles. Instead, spindle fibers are formed by the aggregation of tubulin proteins on the surface of the nuclear envelope during prophase.

4. *Make a list of the events of mitosis.*

Ans: The sequence of events in mitosis is divided into two major phases i.e. the division of the nucleus known as karyokinesis; and the division of the cytoplasm known as cytokinesis.

Karyokinesis is further divided into:

1. Prophase 2. Metaphase 3. Anaphase 4. Telophase

5. *How is mitosis significant?*

Ans: Refer to Q.No.5 for answer.

6. *Describe the events that occur during the phases of meiosis-I.*

Ans: Refer to Q.No.9 for answer.

7. *Describe the significance of meiosis.*

Ans: Refer to Q.No.10 for answer.

8. *Contrast mitosis and meiosis, emphasizing the events that lead to different outcomes.*

Ans: Refer to Q.No.12 for answer.

9. *Describe necrosis and apoptosis.*

Ans: Refer to Q.No.14 and Q.No.15 for answer.

SHORT QUESTIONS

1. A nerve cell does not divide after its formation. In which phase of cell cycle it is?

Ans: A nerve cell does not divide after its formation It is in the G0 phase of cell cycle.

2. *How is cytokinesis different in plant cells as compared to animal cell?*

Ans: In **animal cells**, cytokinesis occurs by a process known as cleavage. A cleavage furrow develops where the metaphase plate used to be. The furrow deepens and eventually pinches the parent cell into two daughter cells.

Cytokinesis in **plant cells** occurs differently. Vesicles derived from the Golgi apparatus move to the middle of cell and fuse to form a membrane-bounded disc called cell plate or **phragmoplast**. The plate grows outward and more vesicles fuse with it. Finally, membranes of cell plate fuse with plasma membrane and its contents join the parental cell wall. The result is two daughter cells, each bounded by its own plasma membrane and cell wall.

3. *What type of cell division occurs when our wounds are healed?*

Ans: Mitosis occurs when our wounds are healed.

4. *Plants do not make their gametes by meiosis. How it that?*

Ans: Plants' life cycle shows alternation of generations. The cells of diploid sporophyte generation undergo meiosis to produce haploid spores, which grow into haploid gametophyte generations. Gametophyte generation produces haploid gametes through mitosis. The gametes combine to produce diploid zygote. Zygote undergoes repeated mitosis to become diploid sporophyte.

THE TERMS TO KNOW

Anaphase:

Anaphase is a 3rd phase of cell division. In which each kinetochore fibre pulls toward the originating centrosome and divides sister chromatid or homologous pair.

Apoptosis:

Apoptosis is the main type of programmed cell death. During apoptosis, cell shrinks and becomes rounded due to break down of cytoskeleton by enzymes.

Benign:

If tumors remain in their original location for a long time they are called benign tumors.

Budding:

Budding is a type of asexual reproduction. In which cell reproduce only by bud.

Cell cycle:

The series of events from the time a cell produced until it completes mitosis and produces new cells.

Chiasmata:

The complexes formed between the non-sister chromatids of homologous chromosomes during meiosis-1 is called chiasmata.

Crossing over:

The exchange of segments between the non-sister chromatids of homologus chromosomes during meiosis-1.

G0 phase:

The phase of the cell cycle in which a cell remains quiescent and does not divide or prepare for division.

G1 phase:

The phase of interphase in which the cell increases its supply of proteins, makes new organelles, grows in size and makes enzymes for the next phase.

G2 phase:

The phase of interphase in which the cell prepares proteins for the production of spindles fibres.

Homologous chromosomes:

The chromosomes which have same morphology are called homologous chromosomes.

Interphase:

The phase of cell cycle between two successive divisions is called interphase.

Karyokinesis:

The division of the nucleus is called karyokinesis.

Kinetochore:

The complex made of proteins that is attached with the centromere of the chromosomes is called kinetochore.

M phase:

Mitotic phase of the cell cycle is called M phase.

Malignant:

If tumors invade other tissues, they are called malignant tumours and their cells are called cancerous cells.

Metaphase:

The phase of cell division in which two kinetochore spindles from opposite sides attach with each chromosome (in mitosis and meiosis-II) or with homologous pair (in meiosis-I) and metaphase plate is formed.

Metaphase plate:

The arrangement of chromosomes on spindle fibres along the equator of the cell.

Mitosis:

The cell division in which each daughter cell has the same number of chromosomes as were present in the parent cell.

Necrosis:

Necrosis is the accidental death of cells and living tissues.

Non-sister chromatids:

The chromatids of two homologous chromosomes, but not of the same chromosomes.

Phragmoplast:

The cell plate formed during cytokinesis in plant cells is called phragmoplast.

Prophase:

The first phase of cell division.

Sphase:

The phase in interphase during which the chromosomes are duplicated i.e. new chromatids are formed.

Sister chromatids:

Chromatids of a chromosomes are called sister chromatids.

Spindle:

The fibres at which chromosomes attach during cell division.

Synapsis:

The homologous chromosomes line up with each other and form pairs by a process called synapses.

Telophase:

The last phase of karykinesis during which nuclear envelopes is reformed and chromosomes uncoil to form chromatin.

ACTIVITIES

1. Observe various stages of mitosis and meiosis through slides, models and charts.

SCIENCE, TECHNOLOGY AND SOCIETY

1. Describe the inability of some mature cells (nerve cells) to divide and the uncontrolled division of certain cells (tumors).

ON-LINE LEARNING

- www.columbia.edu
- www.agen.ufl.edu/…/lect/lect_15/lect_15.htm
- http://sps.k12.ar.us/massengale/biology %201%20page.htm
- www.cell-research.com

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **Mitosis consist of phases:** (LHR. GI)
   (A) One (B) Two (C) Three (D) Four
2. **Those cells which give rise to gametes are called:** (LHR. GII)
   (A) Somatic Cells (B) Spindles Fibers (C) Germ line cells (D) Synapsis
3. **In which phase, cell prepares proteins that are essential for the production of spindle fibres in the phase?** (GRW. GII)
   (A) G1-phase (B) S.phase (C) G2-phase (D) G0-phase
4. **When the tumors remain in their original location are called:** (FBD. GII)
   (A) Benign tumors (B) Malignant tumors (C) Metasis (D) None of these

5. **The word Meiosis derived from Greek, means:** (MLN. GI)
(A) To shorten (B) To make greater (C) To cut (D) To duplicate
6. **In which stage of cell cycle, the cell is preparing enzymes for chromosomes duplication?** (SWL. GI & GII)
(A) S-phae (B) G-1 phase (C) G-2 phase (D) M-phase
7. **Cells that form the body of the organism are called:** (SWL. GII)
(A) parent cells (B) daughter cells (C) somatic cells (D) germ line cells
8. **The division of nucleus is called:** (SGD. GI)
(A) Cyto kinesis (B) Tetrad (C) Chiasmata (D) Karyokinesis
9. **The longest phase in meiosis is:** (SGD. GII, BWP. GII, GRW. GI)
(A) Metaphase I (B) Anaphase I (C) Telophase I (D) Prophase I
10. **In which phase of mitosis, nuclear envelope of a cell is broken down?** (RWP. GII)
(A) Prophase (B) Metaphase (C) Anaphase (D) Telophase
11. **It can cause Necrosis in some areas:** (DGK. GI)
(A) Dog bites (B) Spider bites (C) Snake bites (D) Mosquito bites
12. **Which event distinguishes meiosis from mitosis:** (DGK. GII)
(A) Breakage of nuclear envelope (B) Condensation of chromosomes
(C) Pairing of homologous chromosomes (D) Formation of metaphase plate
13. **Sea Star gains its lost arm by:** (BWP. GI)
(A) Budding (B) Meosis (C) Regeneration (D) Fragmentation
14. **The water lost percent by Transpiration is:** (BWP. GI)
(A) 80% (B) 30% (C) 90% (D) 40%
15. **The division of cytoplasm is called:** (LHR. GI)
(A) Karyokinesis (B) Cytokinesis (C) Phargmoplast (D) Phagocytosis
16. **During which phase of cell cycle spindles fibre are formed:** (LHR. GII)
(A) Metaphase (B) Prophase (C) Interphase (D) G-2 phase
17. **The tumors which remain at their production site are called:** (GRW. GII)
(A) benign (B) malignant (C) metastasis (D) denign
18. **The phase in which crossing over occur:** (FBD. GI)
(A) Anaphase (B) Metaphase (C) Prophase II (D) Prophase I
19. **Which stage of cell division is very different in animal and plant cell division?** (FBD. GII)
(A) Telophase (B) Metaphase (C) Cytokinesis (D) Anaphase
20. **The chromosomes arrange themselves along the equator of the cell in phase:** (MLN. GI, SWL. GI)
(A) Prophase (B) Metaphase (C) Anaphase (D) Telophase
21. **In 1911, ... observed crossing over in Fruit Fly:** (MLN. GII)
(A) Mendel (B) Weismann (C) Morgan (D) Lamarck

22. At which stage of cell cycle cell stop dividing. (SGD. GI)
(A) G 0 (B) G1 (C) G 2 (D) S

23. Duplication of Chromosomes occur in. (SGD. GII)
(A) S Phase (B) M Phase (C) G1 Phase (D) Prophase

24. Complete set of spindle fibre is known as: (RWP. GI)
(A) Chromatin (B) Kinetochore (C) Mitotic spindle (D) Cleavage

25. Asexual reporduction in hydra is done by: (RWP. GII)
(A) Mitosis (B) Budding (C) Cutting (D) Spore

26. Error in the control of mitosis may cause: (DGK. GI)
(A) Cancer (B) Ulcer (C) Constipation (D) Cough

27. Accidental Death of Cells and Living Tissues is called: (BWP. GI)
(A) Necrosis (B) Apoptosis (C) Somatic Cells (D) Synapsis

28. The longest phase of Cell Cycle is: (BWP. GII)
(A) Interphase (B) Prophase (C) Metaphase (D) Telophase

Answers

1. Four	2. Germ line cells	3. G1-phase	4. Benign tumors
5. To shorten	6. G-1 phase	7. somatic cells	8. Karyokinesis
9. Prophase I	10. Prophase	11. Spider bites	
12. Pairing of homologous chromosomes		13. Budding	14. 90%
15. Cytokinesis	16. G-2 phase	17. benign	18. Prophase I
19. Cytokinesis	20. Metaphase	21. Mendel	22. G 0
23. S Phase	24. Mitotic spindle	25. Budding	26. Cancer
27. Necrosis	28. Interphase		

☆ Give short answer to the following questions.

1. Illustrate Somatic Cells with an example. (LHR. GI)

Ans: Those cells which give rise to cells of animal bodies are called somatic cells.They increase cells in livings by means of mitosis.

Example: Epithelial tissues which covers outside of body and lines organs and cavities.

2. What is the difference between somatic cells and germ line cells? (GRW. GI, MLN. GII, LHR. GII, SWL. GII)

Ans: Somatic cells are those which form the body of organisms, while germ line cells are those which give rise to gametes.

3. Define disjunction. (GRW. GII, FBD. GI)

Ans: When the separation of sister chromatids is normal, it is called disjunction.

4. What is metastasis? Write its role in Cancer. (FBD. GII, BWP. GI)

Ans: Malignant tumours can send the cancer cells to other parts of body where new tumors may form. This phenomenon is called metastasis. In metastasis when tumours spread within body they destroy further normal cell to form cancerous tumours. This process help in spread of cancer.

5. Define Crossing Over. (MLN. GI, SWL. GII, RWP. GI, DGK. GII, BWP. GI)

Ans: The exchange of segments between the non-sister chromatids of homologous chromosomes during meiosis-1 is called Crossing Over,

6. Define Chiasmata and Crossing over. (MLN. GII)

Ans: Chiasmata: The two non-sister chromatids of homologous chromosome join each other at certain points along their length. These points of attachment are called chiasmata.

Crossing over: The exchange of segments between the non-sister chromatids of homologous chromosomes during meiosis, this process is called crossing over.

7. Write the name of two major phases during mitosis. (SWL. GI)

Ans: Major phases of mitosis are:

1. Karyokinesis
2. Cytokinesis

8. Define regeneration. (SWL. GI, SGD. GI, DGK. GII, MLN. GII)

Ans: Ability of an organisms to regenerate its lost body part is called regeneration.

Example: Sea star regenerates its lost arm through mitosis.

9. What do you mean by S-phase? (SWL. GII, RWP. GII, FBD. GI)

Ans: The phase in interphase during which the chromosomes are duplicated i.e. new chromatids are formed.

10. Differentiate diploid and Hapaloid cells. (SGD. GI)

Ans: Those cells in which chromosomes are found in pair form i.e 2n they are known as diploid cells, while those cell which have half number of chromosome i.e (1n) are called haploid cells.

11. What is meant by cleavage furrow? (SGD. GII)

Ans: A cleavage furrow develops where the metaphase plate used to be this furrow deepens and eventually pinches the parent cell into two daughter cells.

12. Write a short note on the division of cytoplasm. (SGD. GII)

Ans: Cytokinesis is the division of the cytoplasm. It is different in animal and plant cells. In animal cells, cytokinesis occurs by a process known as cleavage while cytokinesis in plant cells occurs differently.

13. What is main function during G2 phase of cell cycle? (RWP. GI)

Ans: The main function of this phase is that cell prepares proteins for the production of spindles fibres.

14. When and who discovered meiosis? (DGK. GI)

Ans: Meiosis was discovered and described for the first time by a German biologist Oscar Hertwig in 1876.

15. What is the difference between Benign and Malignant Tumor?

(LHR. GII, BWP. GI, MLN. GI, GRW. GII, DGK. GII, SGD. GII)

Ans: Benign Tumor: As long as these tumours remain in their original location, they are

called benign tumours.

Malignant Tumor: If they invade other tissues, they are called malignant (cancerous) tumours and their cells are called cancer cells.

16. What do you know about G_1 Phase in Cell Cycle? (BWP. GI)

Ans: G1 phase is the first phase of cell cycle in which the cell increases its supply of proteins, increases the number of its organelles (such as mitochondria, ribosomes), and grows in size. This phase is also marked by the synthesis of various enzymes that are required in next phase i.e. S phase for the duplication of chromosomes.

17. What is Cell Cycle? Write its two major phases. (BWP. GII, LHR. GI, FBD. GI & GII)

Ans: "The cell cycle is the series of events from the time a cell is produced until it completes mitosis and produces new cells."

Two major phases of cell cycle are:

1. Mitotic Phase
2. Interphase

18. Define apoptosis. (LHR. GII)

Ans: The death of cell according to program is called apoptosis.

19. Give two advantages of apoptosis. (LHR. GII)

Ans:
1. Apoptosis remove the damaged cell.
2. Apoptosis also gives advantages during development.

20. Differentiate between blebs and apoptotic bodies. (GRW. GI)

Ans: The cell membrane makes irregular buds known as blebs, while those blebs which are break off from the cell are called apoptotic bodies.

21. Differentiate between disjunction and non-disjunction. (GRW. GII)

Ans: The normal separation of chromosomes in meiosis is termed as disjunction, while if the separation is not normal, it is known as non-disjunction.

22. By whom and when was the process of mitosis discovered? (FBD. GI)

Ans: In 1880 a German biologist walther Flemming discovered the process of Mitosis.

23. Explain S phase in cell cycle. (FBD. GI)

Ans: In this phase, cell duplicates its chromosomes. As a result each chromosome consist of two sister chromatids.

24. What is chiasmata? (FBD. GII)

Ans: The two non sister chromatids of homologous chromosomes join each other at certain points along their length. This point of attachment is called chiasmata.

25. State Cytokinesis. (LHR. GI, MLN. GI)

Ans: The division of cytoplasm is known as cytokinesis. In animals cytokinesis accur by cleavage, while in plants this process occur differently.

26. Describe G2 Phase. (RWP. GII, MLN. GII, D.GK. GII, SGD. GII)

Ans: In G2 phase cell prepare protein which are essential for mitosis mainly for the formation of spindle fibres. Inhibition of protein synthesis during G2 phase

prevents cell from undergoing mitosis.

27. What is meant by tumor? (SWL. GI)

Ans: As a result of mutations in genes and cells, they continue to divide which result in growth of abnormal cells called tumors.

28. What is mitosis and give its one benefit? (SWL. GI & GII, RWP. GII, BWP. GII)

Ans: Mitosis: The type of division in which a cells divide in to two daughter cells is called mitosis each having same number of chromosomes as in parent cells.

Advantage: The number of cells in an organism increase by mitosis.

29. What is the importance of crossing over in meiosis. (SGD. GI, RWP. GI)

Ans: During meiosis each chromosomes of parent cell under go crossing over. This is the reason that genetic variations come in gametes, ,which fuse to from new individuals. That is why meiosis is used to form variations in organisms. Beneficial variations help organisms to adopt to the changes in environment.

30. Define synapsis and crossing over. (FBD. GI, SGD. GII)

Ans: Synapsis: The homologous chromosomes line up with each other and form pairs this is called synapsis.

Crossing over: The phenomenon in which non sister chromatids exchange their segments is called crossing over.

31. Define Mitosis and Meiosis. (RWP. GII, GRW. GI)

Ans: Mitosis: The cell division in which each cell is divided into two daughter cells having same number of chromosomes as in parent cell is called mitosis.

Meiosis: The type of cell division which forms gametes in animals and spores in higher plants, each with half the usual number of chromosomes is called meiosis.

32. Define Karyokinesis and Cytokinesis. (LHR. GI, BWP. GII)

Ans: The division of nucleus is called karyokinesis, while division of cytoplasm is called cytokinesis

33. Write two difference between mitosis and meiosis. (FBD. GII)

Ans: Mitosis:

1. Homologous chromosomes do not form pairs. There is no crossing over.
2. Daughter nuclei contain diploid number of chromosomes.

Meiosis:

1. Pairing of chromosomes Crossing over between homologous chromosomes.
2. Daughter nuclei contain haploid number of chromosomes.

Q.1. What do you mean by metabolism? Also write about anabolism and catabolism.

Ans: METABOLISM:

The set of all the biochemical reactions (ردعمل) that occur in living organisms to carry out all life activities (حیاتی سرگرمیاں), is called metabolism, e.g. growth (پرورش), reproduction (عمل تولید), maintenance of structures and respond (جوابی عمل) to the environments.

Importance of metabolism:

Metabolism is essentially related to the energy transfers. During metabolism, chemicals are transformed from one form to the other by enzymes because they act as **biocatalysts** and speed up and regulate the metabolic pathways (راستے).

Anabolism: Anabolism includes the biochemical reactions in which larger molecules are synthesized.

Energy is usually used in anabolism.

Catabolism: Catabolism includes the biochemical reactions in which larger molecules are broken down. Energy is usually released. Products of catabolism can be reassembled (اکٹھے کیے جا سکتے ہیں) by anabolic processes into new molecules.

Q.2. How would you define enzymes? What do you know about activation energy? Write how enzymes work.

Ans: ENZYMES:

Enzymes are proteins that catalyze (i.e speed up) biochemical reactions and are not changed during the reaction.

Substrate:

The molecules at which enzymes act are called substrates.

Products:

The enzymes convert (تبدیل کرتے ہیں) substrate into different molecules. These

molecules are called products.

Activation energy:

All chemical reactions require activation energy.

Definition:

Activation energy can be defined as minimum (کم سے کم) energy required to start a reaction.

Mechanism of enzyme action:

The need for activation energy acts as a barrier to the beginning of reaction. Enzymes lower such barriers by decreasing the requirement of activation energy. Thus, in the presence of enzymes reactions proceed at a faster rate.

Concept of activation energy

Working of enzymes:

Enzymes lower the activation energy in several ways.

They do so by:

i. altering the shape (شکل) of the substrate and reducing the amount of energy required to complete the transition.

ii. disrupting the charge distribution.

iii. bringing substrates in the correct orientation to react.

Categories of enzymes:

Enzymes can be categorized on the basis of the site (جگہ) where they work they may be.

(i) **Intracellular.** (e.g. enzymes of glycolysis working in the cytoplasm)

(ii) **Extracellular.** (e.g pepsin enzyme working in the stomach (معدہ) cavity).

Enzymes lower the activation energy

6.1 CHARACTERISTICS OF ENZYEMS

Q.3. Write some introduction of enzyme. Also write different characteristics of enzymes. **OR**

How would you define enzymes? Describe their characteristics?

Ans. Introduction of Enzymes:

In 1878, German physiologist **Whinhelm Kuhne** first used the term enzyme.

1. **Shape & Size:** Almost all enzymes are protein i.e. they are made of amino acids. Enzymes are globular (گول مول) proteins. Like all proteins, enzymes are made of long, linear (سیدھا) chains of amino acids that fold to produce a three-dimensional (تین سمتی

molecule.

2. **Speed of Enzymatic Reactions:** Most enzyme reaction rates are millions of times (لاکھوں گنا) faster than those of comparable uncatalyzed reactions.
3. **Inconsumable:** As with all catalysts, enzymes are not consumed (ختم نہیں ہوتے) by the reactions they catalyze.
4. **Specificity:** Enzymes are usually very specific (مخصوص) for the type of reaction and for the nature of their substrates.
5. **Active Site:** Only a small portion of the enzyme molecule is directly involved in catalysis. This catalytic region is known as the **active site**. It recognizes and binds the substrate, and then carries out the reaction.
6. **Enzyme Regulation:** Enzyme production can be enhanced (بڑھائی جاسکتی ہے) or diminished by a cell according to need. Enzyme activity can also be regulated by **inhibitors** and **activators**.
7. **Cofactors:** Some enzymes require non-protein molecules or ions called cofactors for activity. Cofactors can be either **inorganic** (e.g. metal ions) or **organic** (e.g. flavin and heme).

   If organic cofactors are tightly bound (کَس کے جڑے ہوتے) to enzyme, they are called **prosthetic groups**, but if they are loosely (ڈھیلے) attached with enzyme, they are called **coenzymes**. Coenzymes transport chemical groups from one enzyme to another. Some important coenzymes are vitamins e.g. riboflavin, thiamine and folic acid.
8. **Metabolic Pathways:** Several enzymes can work together in a specific order, creating metabolic pathways, in which one enzyme takes the product of another enzyme as a substrate. After the reaction, the product is passed on the next enzyme.

Q.4. Write down few industrial uses of enzymes.

Ans: Enzymes are extensively (بڑے پیمانے پر) used in different industries for fast chemical reactions. For example:

(a) **Food industry:** Enzymes are used in production of white bread, buns etc.
(b) **Brewing industry:** Enzymes break starch and proteins. These products are used by yeast for fermentation (to produce alcohol).
(c) **Paper industry:** Enzymes break starch to lower its viscosity that aids in making paper.
(d) **Biological detergent:** Protease enzymes are used for the removal of protein stains (داغ) from clothes. Amylase enzymes are used in dish washing to remove resistant starch residues.

Q.5. Discuss different factors affecting the rate of enzyme action.

Ans: FACTORS AFFECTING THE RATE OF ENZYME ACTION:

The activity of an enzyme is affected by any change in conditions that alters its

chemistry and its shape as they are very sensitive (حساس) to the environment in which they work.

Following factors can affect the rate of enzyme activity.

1. Temperature *2.* Substrate concentration *3.* pH

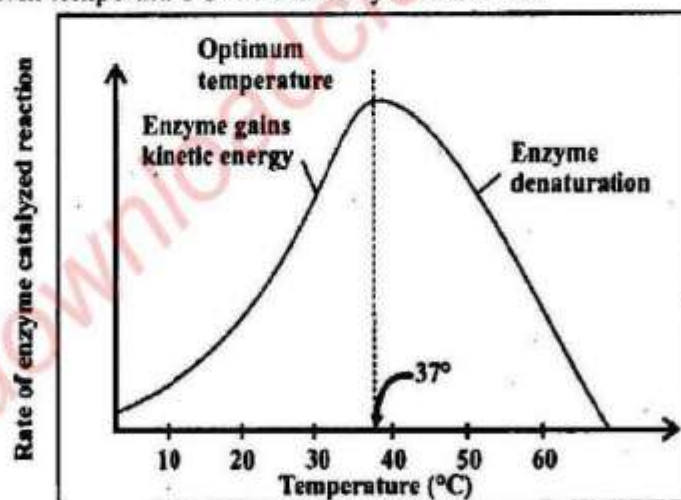
1. Temperature:

Increases in temperature speeds up the rate of enzyme catalyzed reactions, but only to a point.

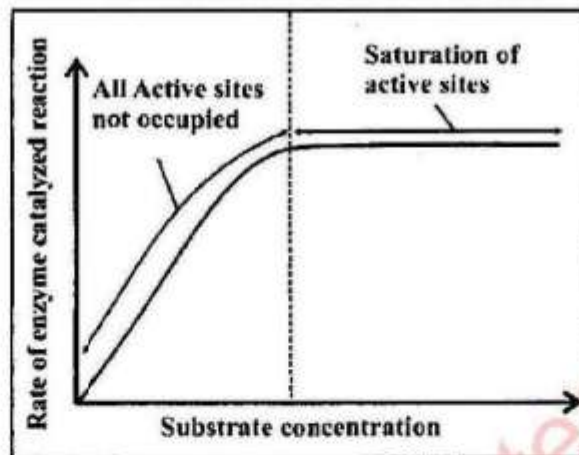
Optimum (زیادہ سے زیادہ) temperature:

Every enzyme works at its maximum rate at a specific temperature called as the **optimum temperature** for that enzyme.

When temperature rises to a certain limit (خاص حد), heat adds in the activation energy and also provides kinetic energy for the reaction. So reactions are accelerated (تیز ہو جاتے ہیں). But when temperature is raised well above the optimum temperature, heat energy increases the vibrations (حرکات) of atoms of enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme. It results in a rapid decrease in the rate of enzyme action and it may be blocked completely.

The optimum temperature of human enzymes is 37°C.

Effect (اثر) of temperature on enzyme activity

2. Substrate concentration:

If enzyme molecules are available in a reaction, an increase in substrate concentration increases the rate of reaction. If the enzyme concentration is kept constant and the amount of substrate is increased, a point is reached where any further increase in substrate does not increase the rate of reaction any more. When the active sites of all enzymes are occupied (at high substrate concentration), any more substrate molecules do not find free active sites. This state (حالت) is called **saturation** (سیرشدگی) of active sites and reaction rate does not increase.

Effect of substrate concentration of enzyme activity

3. *pH:*

All enzymes work at their maximum rate at a narrow (تنگ) range of pH, called as the optimum pH. A slight change (increase or decrease) in this pH causes retardation (رکاوٹ) in enzyme activity or blocks it completely.

Effect of pH on enzyme activity

Every enzyme has its specific optimum pH value:

For example: Pepsin (working in stomach) is active in acidic medium (low pH) while trypsin (working in small intestine (چھوٹی آنت)) shows its activity in alkaline medium (high pH). Change in pH can affect the ionization of the amino acids at the active site.

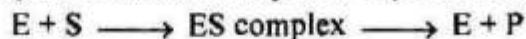
6.2 MECHANISM OF ENZYME ACTION

Q.6. How enzyme-substrate (ES) complex is formed?

Ans: When enzyme attaches with substrate, a temporary enzyme-substrate (ES) complex is formed.

Enzyme catalyzes the reaction and substrate is transformed into product.

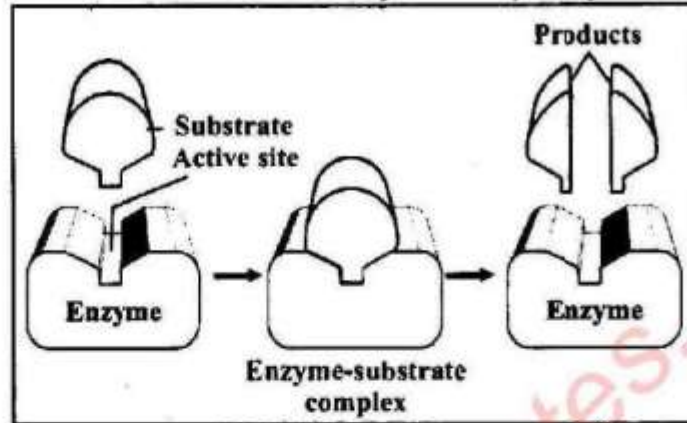
After it, the ES complex breaks and enzyme and product are released.

$$E + S \longrightarrow ES\ complex \longrightarrow E + P$$

Q.7. Describe the lock and key model and induced fit model of enzyme action.

Ans: LOCK AND KEY MODEL:

A German chemist **Emil Fischer**, in 1894, proposed the **lock and key model** in order to explain the mechanism of enzyme action.

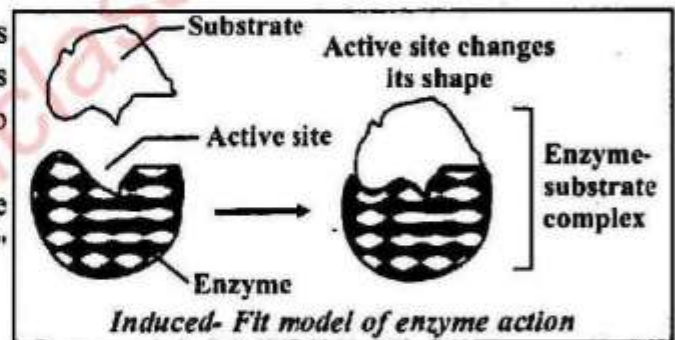
According to this model, both enzyme and substrate possess (رکھتے) specific shapes

that fit exactly into one another. This model explains enzyme specificity (تخصیص).

Lock and key model of enzyme action

INDUCED-FIT MODEL:

An American biologist, **Daniel Koshland**, in 1958 proposed the induced-fit model of enzyme action.

According to him, active site is not a rigid (بے لچک) structure rather it is molded into the required shape to perform its function.

The "induced fit model" is more acceptable than the "lock and key" model of enzyme action.

Induced- Fit model of enzyme action

6.3 SPECIFICITY OF ENZYMES

Q.8. What characteristic of enzymes makes them specific for substrates?

Ans: ENZYME SPECIFICITY:

There are over 2000 known (دریافت شدہ) enzymes, each of which is involved in one specific chemical reaction. Enzymes are also substrate specific.

Activity of protease enzyme:

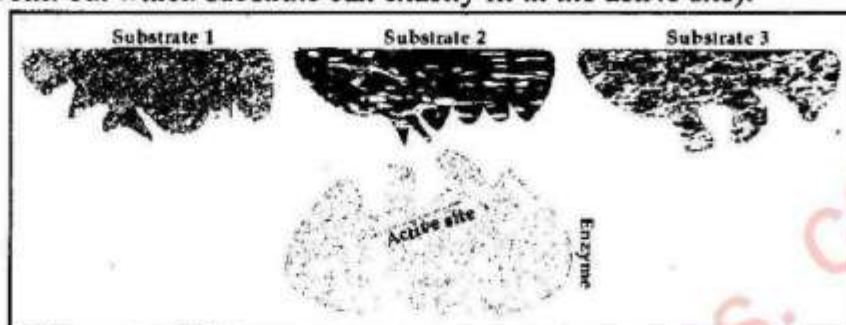
The enzyme protease (which breaks peptide bonds in proteins) will not work on starch (نشاستہ) (which is broken down by an enzyme amylase).

Activity of lipase:

Lipase enzyme acts only on lipids and digests them into fatty acids and glycerol.

Role of active site in enzyme specificity:

The specificity of different enzymes is determined (پرکھی جاتی ہے) by the shapes of their active sites. The active sites possess specific geometric shapes that fit with specific substrates.

The geometric shape of the active site of the enzyme determines its specificity for substrate. (point out which substrate can exactly fit in the active site).

Specificity of enzyme due to the geometric shape of active site.

Substrate 3 can exactly fit in the active site.

Q.9. How will you perform an experiment to show the working of an enzyme in vitro?

Ans: Enzymes can catalyze in-vivo (inside the living cells) and in-vitro (in the glass ware) reactions. We can design an experiment to observe the in-vitro enzyme activity. For this purpose we will select meat proteins as substrate and pepsin (ہضم کرنے والا مادہ) as the protein digesting (پروٹین ہضم کرنے والے) enzyme.

Problem: Can pepsin digest the proteins present in meat?

Apparatus required:

Meat, Test tube, pepsin solution, HCl, Biuret reagent.

Background information:

- Animal flesh (meat) contains lot of proteins.
- Pepsin enzyme is produced in stomach (in its inactive form pepsinogen). It acts on protein molecules and digests them to peptides.
- In-vitro means outside living body (in artificial environment) while in-vivo means inside living body.

Procedure:

1. Take a small piece of meat in two test tubes and pour 15 ml of pepsin in one of them and pour 15 ml water in the second tube (for comparison (تقابل کے لیے)).
2. Add 10 drops of HCl in both test tubes and place them at 37°C in incubator.

Observation: Observe the piece of meat after four hours. Perform the Biuret test to confirm the presence of proteins in both tubes.

Results: The Biuret test gives negative (منفی) results in the tube in which pepsin was added. It confirms that no proteins are present in this test tube and all have been digested by the enzyme pepsin.

Evaluation:

i. What effect did pH have on pepsin activity?

Ans: Pepsin works in acidic (تیزابی) medium.

ii. What is the optimum pH for pepsin?

Ans: pH 2

iii. An organism lives in a hot springs. What will be the effect on its enzymes if it is placed in cold water?

Ans: Enzyme activity will become slow as its enzymes have optimum temperature of hot springs.

Q.10. How will you perform an experiment to show the working of amylase in vitro.

Ans: Amylase is an enzyme that catalyses the breakdown of the polysaccharide starch to the disaccharide maltose. It is present in saliva (لعاب), plant tissues, and also in seeds (بیج). To observe the in-vitro enzyme activity we can select starch as substrate and amylase as the starch digesting enzyme.

Problem: Can amylase digest starch?

Apparatus required: Meat, Test tube, pepsin solution, HCl, Biuret reagent.

Background information:

- Starch turns iodine solution dark purple/black while disaccharides do not react with the iodine.

Procedure:

1. Prepare 1% solution of amylase and put some of it in a test tube.
2. Add 2 ml of starch solution in the test tube.
3. Incubate the test tube at 37°C for 15 minutes.

Observation: Observe the test tube after 15 minutes. Perform iodine test to confirm the presence (موجودگی) of starch. This can be done by putting few drops of iodine solution in the test tube. Observe the color change in the test tube.

Results: The iodine test gives negative results. There was no color change. It confirms (ثابت کرتا ہے) that no starch is present in the test tube and all have been digested into disaccharides.

Evaluation:

i. What color appears when iodine test is positive (مثبت)?

Ans: Blue-black

ii. Why was the experimental test tube incubated at 37°C?

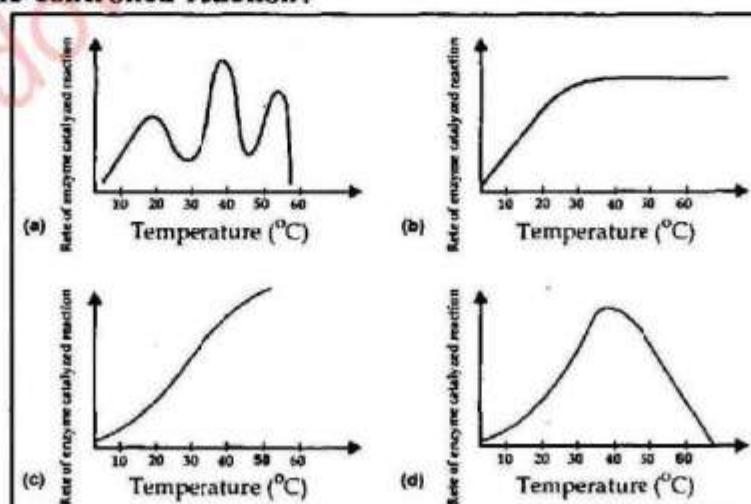
Ans: It is the normal (عام) body temperature of human being. And all enzymes show its maximum activity at this temperature.

iii. If we perform the iodine test on starch solution before putting it in amylase, what would be the results?

Ans: Blue-black.

Review Questions

MULTIPLE CHOICE

1. **What is TRUE about enzymes?**
   (a) They make biochemical reactions to proceed spontaneously
   (b) They lower the activation energy of a reaction
   (c) They are not very specific in their choice of substrates
   (d) They are needed in large quantities
2. **To what category of molecules do enzymes belong?**
   (a) Carbohydrates (b) Lipids (c) Nucleic acids (d) Proteins
3. **What is TRUE about cofactors?**
   (a) Break hydrogen bonds in proteins (b) Help facilitate enzyme activity
   (c) Increase activation energy (d) Are composed of proteins
4. **Prosthetic groups are:**
   (a) Required by all enzymes (b) Loosely attached with enzymes
   (c) Proteins in nature (d) Tightly bound to enzyme
5. **When we add more substrate to an already occurring enzymatic reaction and there is no increase in the rate of reaction, what would you predict?**
   (a) All active site have been occupied by substrate molecules
   (b) The enzyme molecules have denatured
   (c) More substrate acted as inhibitor
   (d) More substrate has disturbed the pH of the medium
6. **Which of these graphs correctly shows the effect of temperature on the rate of an enzyme-controlled reaction?**

Ans: 1. They lower the activation energy of a reaction 2. Proteins
3. Help facilitate enzyme activity 4. Tightly bound to enzyme

5. All active site have been occupied by substrate molecules **6.** (d)

UNDERSTANDING THE CONCEPTS

1. How would you define enzymes? Describe their characteristics.

Ans: Refer to Q.No.3 for answer.

2. What do you mean by activation energy and why is it referred in the definition of enzyme?

Ans: All chemical reactions of a cell need energy to break chemical bonds and begin the reaction. This energy is called activation energy.

The need for activation energy acts as a barrier to the beginning of reaction. Enzymes lower such barriers by decreasing the requirement of activation ĕnergy. Thus, in the presence of enzymes, reactions proceed at a faster rate.

Enzymes lower the activation energy in several ways. They do so by:

i. Altering the shape of the substrate and reducing the requirement of energy for its change.

ii. Disrupting the charge distribution, on substrate.

iii. Bringing substrates in the correct orientation to react.

3. In a range of 0-35°C, the rate of reaction of an enzyme is proportional to temperature. Above 35°C and below 0°C, enzyme activity slows down and eventually stops. Explain why?

Ans: The optimum temperature for the maximum working speed of human enzyme is 37°C.

Relation of enzyme with increasing temperature:

Increase in temperature speeds up the rate of enzyme catalyzed reactions, but only to a point.

Optimum temperature:

Every enzyme works at its maximum rate at a specific temperature called as the optimum temperature for that enzyme.

For human optimum temperature is 37°C:

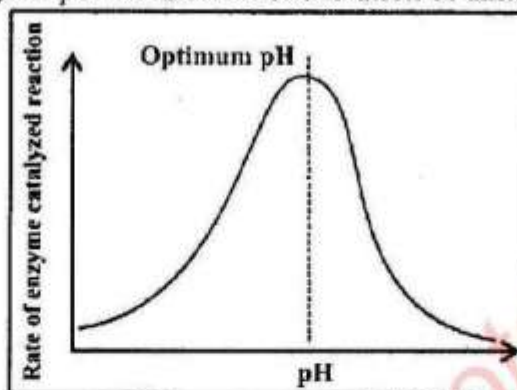
Its mean all the metabolism in humans will increase. In a range of 0-37°C. When temperature rises to 37°C, heat adds in the activation energy and also provides kinetic energy for the reaction. So reactions are accelerated.

But when temperature is raised well above the optimum temperature, heat energy increases the vibrations of enzyme and the globular structure of enzyme is lost. It slows the activity of enzyme and it may be blocked completely.

4. How does pH affect enzyme activity?

Ans: All enzymes work at their maximum rate at a narrow range of pH, called as

optimum pH.

A slight change in its pH causes retardation in enzyme activity or blocks it completely. Change in pH can affect the ionization of amino acids at the active site.

Examples:

(1) Pepsin is active in acidic medium.

(2) Trypsin shows its activity in alkaline medium.

5. *What characteristic of enzymes makes them specific for substrates?*

Ans: Refer to Q.No.8 for answer.

6. *Briefly describe the factors that affect the activity of enzymes.*

Ans: Refer to Q.No.5 for answer.

7. *Describe the lock and key mechanism of enzyme action.*

Ans: Refer to Q.No.7 for answer.

SHORT QUESTIONS

1. *Define cofactor and coenzyme.*

Ans: **Cofactor:** Some enzymes require non-protein molecules or ions called cofactors for activity.

Coenzymes: If organic cofactors are loosely attached with enzyme, they are called coenzymes.

Some important coenzymes are vitamins.

2. *What is the main use of enzymes in paper industry?*

Ans: Enzymes break starch to lower its viscosity that aids in making paper.

THE TERMS TO KNOW

Activation energy:

Minimum energy required to start a reaction is called activation energy.

Active site:

Only a small portion of enzyme molecule is directly involved in catalysis. This

catalytic region is known as active site.

Amylase:

Amylase is an enzyme which only works on carbohydrate or starch.

Anabolism:

Anabolism is a type of metabolism in which small molecules combine with each other and make large and complex molecules.

Biocatalyst:

The catalyst which is used to speed up the biochemical reaction is called biocatalyst.

Catabolism:

Catabolism is a process in which larger and complex molecules break into small and simple molecules with release of energy.

Catalyst:

Catalyst is a substance which speeds up the chemical reaction. It does not directly take part in a chemical reaction.

Coenzyme:

If organic cofactors are loosely attached with enzyme, they are called co-enzymes.

Cofactor:

The non-protein molecules or ions required by enzymes for its activity is called co-factor.

Denaturation:

Damage or loss of structure of a molecule is called denaturation.

Optimum pH:

All enzymes work at their maximum rate at a narrow range of pH, called as optimum pH.

Optimum temperature:

Every enzyme works at its maximum rate at a specific temperature called as the optimum temperature for the enzyme.

Enzyme:

Enzyme are proteins that catalyze biochemical reactions and are not changed during the reaction.

Enzyme-substrate complex: Enzyme-substrate complex is a temporary complex which is formed when enzyme attaches with substrate.

Lipase: Lipase is an enzyme which works on lipids only.

Lock-and-key model: According to this model, both enzyme and substrate possess specific shapes that fit exactly into one another.

Metabolism: Metabolism is the set of biochemical reactions that occur in living organisms in order to maintain life.

Product: The molecules those are formed as the result of enzymatic reaction are called products.

Saturation: The state at which all the active sites of the enzymes are occupied and any more substrate molecules do not find free active sites is called saturation.

Substrate: The molecules at which enzymes act are called substrates.

INITIATING AND PLANNING

1. Draw graphs showing the effects of temperature, pH, and concentration of substrate on the rate of enzyme-catalyzed reactions.
2. Illustrate through a diagram, the lowering of activation energy by enzyme.

ACTIVITIES

1. Perform experiment to show the in-vitro working (in test tube) of pepsin on meat.
2. Perform experiment to show the in-vitro working (in test tube) of amylase on starch.

SCIENCE, TECHNOLOGY AND SOCIETY

1. List the uses of enzymes in different industries.

ON-LINE LEARNING

- en.wikipedia.org/wiki/ezyme
- www.biology-online.org/dictionary/ezyme
- encarta.msn.com/encyclopedia_761575875/enzyme.html
- www.brooklyn.cuny.edu/bc/ahp/bioweb/

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **Starch is broken down by an enzyme called:** (LHR. GI, MLN. GII)
   (A) Lipase (B) Pepsin (C) Amylase (D) None of these
2. **Trypsin enzyme works in:** (LHR. GII)
   (A) Stomach (B) Large Intestine (C) Small Intestine (D) Heart
3. **Enzyme used for cleaning utensils is ________.** (GRW. GI)
   (A) Amylase (B) Trypsin (C) Lipase (D) Tylon

4. **To what category of molecules do enzymes belong?** (DGK. GI, LHR. GI & GII, GRW. GII, MLN. GI,)
(A) carbohydrates (B) proteins (C) lipids (D) nucleic acids
5. **Metabolism is derived from Greek word meaning:** (FBD. GI, BWP. GII)
(A) Division (B) Change (C) Deduction (D) Matter
6. **Enzymes are made up of:** (FBD. GII)
(A) Fatty acid (B) Nucleic acid (C) Carbohydrates (D) Amino acid
7. **"Lock and Key" Model of Enzyme Action was proposed by:** (MLN. GI, BWP. GI)
(A) Emil Fischer (B) Daniel Koshland (C) Winhelm (D) Calvin
8. **An Enzyme which breaks down Starch is:** (MLN. GII)
(A) Protease (B) Amylase (C) Tripsin (D) Lipase
9. **Lipase enzyme act on only:** (SWL. GI, RWP. GI, SGD. GII)
(A) carbohydrates (B) proteins (C) lipids (D) starch
10. **Those molecules on which enzymes effect:** (SWL. GII)
(A) substrate (B) products (C) inhibitor (D) activator
11. **Who first used the term Enzyme:** (SGD. GI)
(A) Zacharias Janssen (B) Robert Brown
(C) Winhelm Kuhne (D) Louis Pasteur
12. **Enzyme lipase acts only on:** (RWP. GI)
(A) Lipids (B) Protein (C) Carbohydrates (D) Hormones
13. **Enzyme lipase acts on lipids and convert them into:** (RWP. GII)
(A) Acetic acid (B) Lactic acid
(C) Fatty acids and glycerols (D) Ascorbic acid
14. **To what category of molecules do enzyme belong:** (LHR. GII)
(A) Proteins (B) Carbohydrates (C) Lipids (D) Nucleic acids
15. **Who first used the term 'Enzyme'?** (GRW. GI)
(A) Ibne Nafees (B) Emil Fischer
(C) Winhelm Kuhne (D) Louis Pasteur
16. **When was induced fit model presented?** (GRW. GII)
(A) 1858 (B) 1956 (C) 1963 (D) 1958
17. **Temperature for the maximum working speed of human enzyme is:** (FBD. GI, RWP. GI, MLN. GII)
(A) 30°C (B) 37°C (C) 35°C (D) 32°C
18. **Enzyme used for the removal of protein stains from clothes is:** (SWL. GI)
(A) protease (B) lipase (C) amylase (D) pepsin
19. **The term metabolism is derived from which language?** (SWL. GII)
(A) English (B) Italian (C) Greek (D) Roman
20. **Who proposed the induced fit model of enzyme action.** (SGD. GI)
(A) Emil Fischer (B) Daniel Koshland

(C) Ibn-e-Nafees (D) Jabir Bin Hayan

21. In metabolism works as catalyst. (RWP. GII)
(A) Enzyme (B) Vitamins (C) Protein (D) Lipids

22. Lock and Key model was prepared in: (DGK. GII)
(A) 1824 (B) 1924 (C) 1994 (D) 1894

23. The Catalytic Region on Enzyme is called: (BWP. GII)
(A) Metabolic Slite (B) Co - enzyme (C) Cofactor (D) Active Site

Answers

1. Amylase	**2.** Small Intestine	**3.** Amylase	**4.** proteins	**5.** Change
6. Amino acid	**7.** Emil Fischer	**8.** Amylase	**9.** lipids	**10.** substrate
11. Winhelm Kuhne	**12.** Lipids	**13.** Fatty acids and glycerols		**14.** Proteins
15. Winhelm Kuhne	**16.** 1958	**17.** 37°C	**18.** protease	**19.** Greek
20. Daniel Koshland	**21.** Enzyme	**22.** 1894	**23.** Active Site	

☆ Give short answer to the following questions.

1. What is meant by Substrates? (LHR. GI)

Ans: The molecules at which enzymes act are called substrates.

2. Describe any two uses of Enzymes.
(LHR. GI, SGD. GII, RWP. GI & GII, BWP. GI, FBD. GII, SWL, GII, MLN. GII, GRW. GI & GII)

Ans: 1. Enzymes break starch and proteins to produce simple sugars and amino acids that are used by yeast for fermentation (to produce alcohol).

2. Proteases are used for the removal of protein stains from clothes.

3. Define Optimum PH. (LHR. GI, DGK. GI)

Ans: Every enzyme works at its maximum rate at a specific temperature which is called optimum temperature for the enzyme.

4. Define Catabolism. (LHR. GII, FBD, GII)

Ans: Catabolism is a process in which larger and complex molecules break into simpler molecules with release of energy.

5. What do you mean by Prosthetic group? (LHR. GII, BWP. GII, FBD. GII)

Ans: If organic cofactors are tightly bound to enzyme they are called prosthetic group.

6. What is meant by denature of enzyme? (DGK. GI & GII, GRW. GI & GII)

Ans: When temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of enzyme and the globular structure of enzyme is lost. This is known as denaturation of enzyme.

7. Define Co-factors. (MLN. GII, GRW. GI & GII)

Ans: The non-protein molecules or ions required by enzymes for its activity is called co-factor.

8. What is meant by saturation of active sites? (GRW. GII, BWP. GI)

Ans: The state in which all the active sites of the enzymes are occupied and any more

substrate molecules do not find free active sites is called saturation of active site.

9. Define activation energy. How enzyme lower the activation energy?
(FBD. GI & GII, MLN. GI, BWP. GI & GII, SWL, GII)

Ans: The minimum amount of energy required to start a reaction is called activation energy. Enzyme lower activation energy by following ways.

- By altering the shape of the substrate.
- By distrupting charge distribution.

10. Describe the lock and key model of enzyme action.
(FBD. GI, MLN. GI, GRW. GI, BWP. GII, DGK. GII)

Ans: According to this model, both enzyme and substrate possess specific shapes that fit exactly into one another. This model explains enzyme specificity.

11. Name the factors affecting the rate of enzyme action. (FBD. GI, RWP. GI, LHR. GII)

Ans: Following factors affect the rate of enzyme action.
Temperature, Substrate concentration and pH.

12. Describe effect of temperature on the speed of enzyme action.
(FBD. GII, RWP. GI, LHR. GII, SWL, GII)

Ans: The temperature at which an enzyme works at its best is called optimum temperature.

At low temperatures the enzyme is ineffective. When temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of enzymes and the globular structure of enzyme is lost this is called denaturation of enzyme.

13. What is meant by Active Site? (MLN. GII, SWL. GI, LHR. GI, GRW. GI)

Ans: The small portion of enzyme molecule is directly involved in catalysis. This catalytic region is known as active site.

14. Explain briefly about metabolism. (LHR. G II, SWL. GI & GII, GRW. GII)

Ans: The set of all the biochemical reactions that occur in living organisms to carry out all life activities, is called metabolism, e.g. growth, reproduction, maintenance of structures and respond to the environments.

Importance of metabolism: Metabolism is essentially related to the energy transfers. During metabolism, chemicals are transformed from one form to the other by enzymes because they act as biocatalysts and speed up and regulate the metabolic pathways.

15. Write induced fit model for enzyme action. (SWL. GII, SGD. GI)

Ans: According to this model, active site is not a rigid structure rather it is molded into the required shape to perform its function.

16. Differentiate between catabolism and anabolism. (RWP. GII, SGD. GI & GII)

Ans: Catabolism: Catabolism is a process in which larger and complex molecules are break into small and simple molecules with release of energy.

Anabolism: Anabolism is a type of metabolism in which small molecules combine

with each other and make large and complex molecules.

17. Define the product of an enzyme action. (SGD. GI, BWP. GII)

Ans: The molecules which are formed as the result of enzymatic reaction are called products.

18. What is substrate concentration? (SGD. GII)

Ans: If enzyme molecules are available in a reaction, an increase in substrate concentration increases the rate of reaction. If the enzyme concentration is kept constant and the amount of substrate is increased, a point is reached where any further increase in substrate does not increase the rate of reaction any more. When the active sites of all enzymes are occupied (at high substrate concentration), any more substrate molecules do not find free active sites. This state is called saturation of active sites and reaction rate does not increase.

19. What are biocatalysts? (SGD. GII)

Ans: The catalyst which is used to speed up the biochemical reaction is called biocatalyst.

20. Define cofactor and enzyme. (RWP. GII)

Ans: Cofactor: Some enzymes require non-protein molecules or ions called for activity This is calld cofactor.

Enzyme: Enzymes are proteins that catalyze (i.e speed up) biochemical reactions and are not changed during the reaction.

21. Give examples of intracellular and extracellular enzymes. (RWP. GII, MLN. GII, GRW. GI)

Ans: Enzymes of glycolysis which work in cytoplasm belong intracellular, while pepsin enzyme working in stomach cavity are extracellular enzymes.

22. Write the function of Inhibitor in enzyme action. (DGK. GII)

Ans: Those chemical substance which reduce or slow down the catalytic action of enzyme are known as inhibitors.

23. Who first used the term enzyme? (LHR. GII)

Ans: German physiologist whinhelm kuhne first used the term enzyme.

24. What characteristics of enzyme make them specific for substrates? (FBD. GI)

Ans: The specificity of different enzymes is determined by the shape of their active sites. The active site possess specific geometric shapes that fit with specific substrates.

25. Name the Vitamins which act as coenzyme. (MLN. GII)

Ans: Following enzyme are act as coenzyme riboflavin, thiamine and folic acid.

26. What is the function of Amylase and Lipase? (MLN. GII)

Ans: Amylase catalyse the process of break down of starch, while lipase enzyme act on lipids.

BIOENERGETICS

Major Concepts:

7.1 BIOENERGETICS AND THE ROLE OF ATP

Q.1. Define bioenergetics. What is its relation (تعلق) to the oxidation-reduction reactions in living body?

Ans: BIOENERGETICS:

Bioenergetics is the study of energy relationships and energy transformations (conversions) in living organisms (زندہ اجسام).

Energy Need:

Energy drives all metabolic processes in a cell as substances are entering and leaving the cell all the times to form new substances and break others.

Kinds of Energy:

Energy exists in two forms;

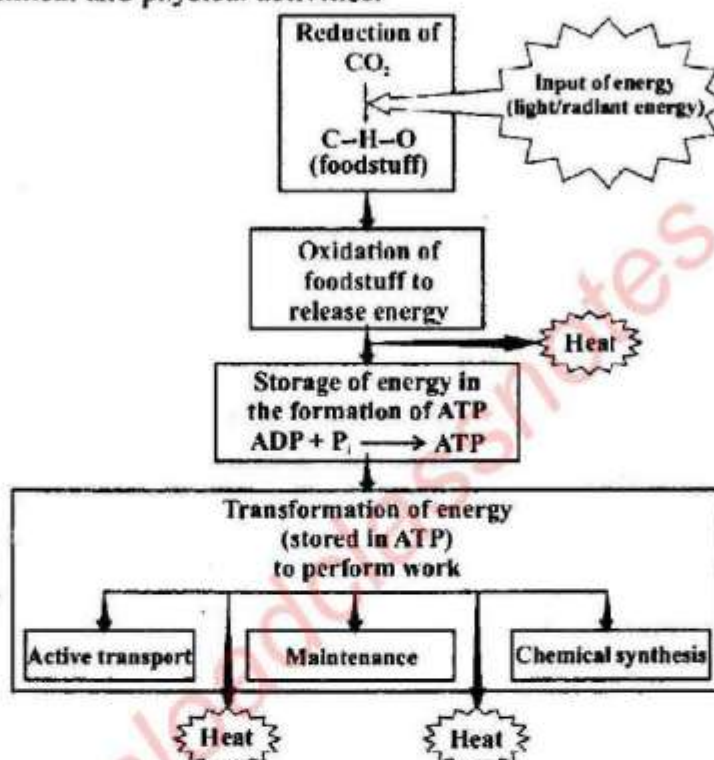
i. ***Kinetic energy:*** It is actively (مستعدی سے) involved in doing work.

ii. ***Potential energy:*** It is stored for future use.

The potential energy is stored in chemical bonds and is released as kinetic energy when these bonds break.

Availability (دستیابی) of Energy:

Living organisms get energy by metabolizing the food they eat or prepare. The food contains potential energy in its bonds. When these bonds are broken down, a large

amount of kinetic energy is usually released (خارج ہوتی ہے). Some of this energy is stored in the form of potential energy in the bonds of ATP molecules while the rest escapes as heat. The potential energy stored in ATP is again transformed into kinetic energy to carry out different chemical and physical activities.

Some energy transformations (تبدیلیاں) in living systems.
Note that heat is lost in every transformation

Oxidation-Reduction Reactions:

Constant energy flow (بہاؤ) during various life processes comprises the acquisition (حاصل کرنا) and use of energy in building, breaking down, assembling, and eliminating (ختم کرنا) substances, which are necessary for the maintenance, growth, and reproduction of organisms.

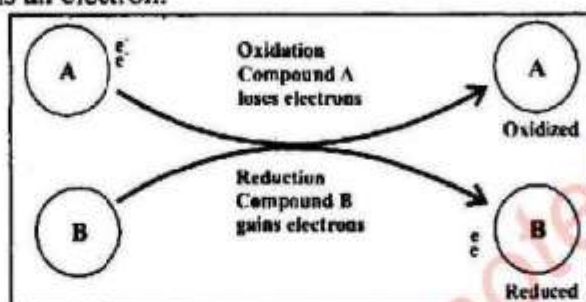
Oxidation-reduction reactions are the direct source of energy for all the life processes. Oxidation-reduction reactions involve exchange (تبادلہ) of electrons between atoms.

Oxidation: The loss of electrons is called oxidation.

Reduction: The gain of electrons is called reduction.

Electrons can be an energy source. It depends upon their location (جگہ) and arrangement in atoms. For example; when they are present in oxygen, they make stable (مستحکم) association with oxygen atom and are not good energy source. But if electrons are dragged away from oxygen and attached to some other atom e.g. carbon or hydrogen,

they make unstable association. They try to move back to oxygen and when this happens, energy is released.

The loss and gain of hydrogen atoms provide energy in living organisms. A hydrogen atom contains one proton and one electron. When a molecule loses a hydrogen atom, it actually loses an electron and similarly (اسی طرح) when a molecule gains hydrogen atom, it actually gains an electron.

Redox reactiosn

Q.2. Interpret that ATP is the chief energy currency of all cells.

Ans: ATP: The Cell's Energy Currency:

The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP).

Discovery of ATP:

ATP was discovered (دریافت کرنا) in 1929 by Karl Lohmann, and was proposed to be the main (اہم) energy-transfer molecule in the cell by the Nobel Prize winner, Fritz Lipmann in 1941.

Uses of ATP:

ATP is the main energy source for majority (زیادہ تر) of the cellular functions like the synthesis of macromolecules (DNA, RNA, and proteins), movement, transmission (ترسیل) of nerve impulses, active transport, exocytosis and endocytosis etc.

Molecular Structure:

The ability of ATP to store and release energy is due to its molecular structure.

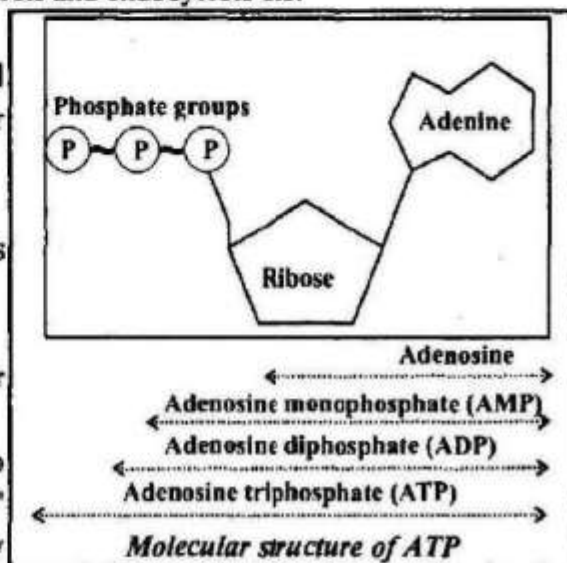
Each ATP molecule has three subunits:

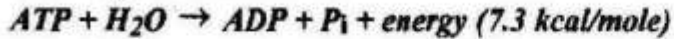
i. Adenine-a double-ringed nitrogenous base

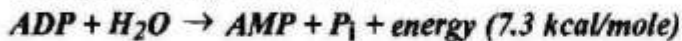
ii. A ribose – a five-carbon sugar

iii. Three phosphate groups in a linear chain.

The covalent bond connecting two phosphates is indicated by the "tilde (~)" and it is a high-energy bond. The energy

Molecular structure of ATP

in this bond is released as it breaks and inorganic phosphate (Pi) gets separated (علیحدہ ہو جاتا ہے) from ATP. The breaking of one phosphate bond releases about 7.3kcal (7,300 calories) per mole of ATP.

$ATP + H_2O \rightarrow ADP + P_i$ + energy (7.3 kcal/mole)

The energy from ATP is sufficient to drive most of the cell's energy-requiring reactions. In common energy reactions only the outermost of the two high-energy bonds breaks. When this happens, ATP becomes ADP (adenosine diphosphate) and one Pi is released. In some cases, ADP is further broken down to AMP (adenosine monophosphate) and Pi as follows:

$ADP + H_2O \rightarrow AMP + P_i$ + energy (7.3 kcal/mole)

Cells constantly recycle ADP by recombining (دوبارہ جوڑنا) it with P_i to form ATP. The synthesis of ATP from ADP and P_i requires the expenditure of 7.3 kcal of energy per mole. This energy is obtained from the oxidation of foodstuff (اشیائے خوردونوش).

ATP is generated by energy-releasing processes and is broken down by energy-consuming processes. In this way ATP transfers energy between metabolic reactions.

7.2 PHOTOSYNTHESIS

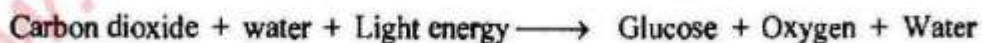
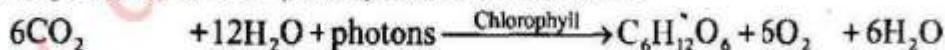
Q.3. How can you define photosynthesis? What are its raw materials (خام مال)?

Ans: PHOTOSYNTHESIS:

Photosynthesis is the manufacturing of glucose with oxygen as a by-product (ضمنی پیداوار) from carbon dioxide and water in the presence of sunlight and chlorophyll. All life depends on photosynthesis.

Photosynthesis is carried out by green plants, algae, and some bacteria. A simple general equation (مساوات) for photosynthesis is as follows:

$$6CO_2 + 12H_2O + \text{photons} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Carbon dioxide + water + Light energy ⟶ Glucose + Oxygen + Water

Uptake of Raw Material:

Water and carbon dioxide are the raw materials of photosynthesis. The plants have elaborate mechanisms for the intake (لینا) and transport (ترسیل) of these raw materials.

Intake of Water:

Water and salts are absorbed by the root hairs through osmosis. This water is eventually transported to leaves through xylem vessels.

Intake of Carbon Dioxide:

The air that enters the leaf through tiny pores (مسام) (stomata) diffuses into the air spaces present around mesophyll cells. Stomata cover only 1-2% of the leaf surface but

they allow much gas to diffuse through them. This air carries carbon dioxide, which gets absorbed in the thin layer of water surrounding (گھیرے ہوئے) the mesophyll cells. From here the carbon dioxide diffuses into the mesophyll cells.

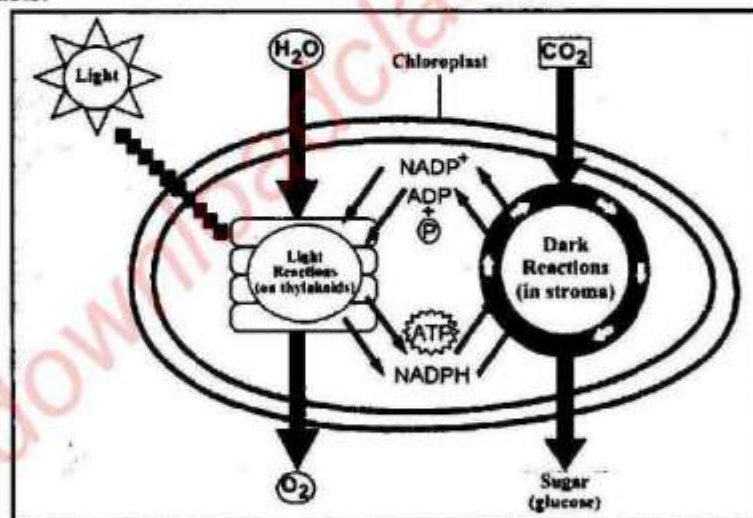
7.2.1 MECHANISM OF PHOTOSYNTHESIS

Q.4. Outline the processes involved in photosynthesis.

Ans: Mechanism Of Photosynthesis:

Photosynthesis occurs in two phases (مرحلے).

i. **Light Reactions:** Light energy is captured and is used to make high-energy molecules (ATP and NADPH). These reactions, which are known as light reactions take place on the thylakoid membranes of chloroplasts.

ii. **Dark reactions:** Carbon dioxide is reduced to make glucose during dark reactions. The energy in the form of ATP is utilized in this process and is then stored in the bonds of glucose. Since these reactions do not use light directly (براہ راست), they are known as dark reactions. The dark reactions take place in the stroma of the chloroplasts.

Summary of photosynthesis

Light Reactions (Z-scheme):

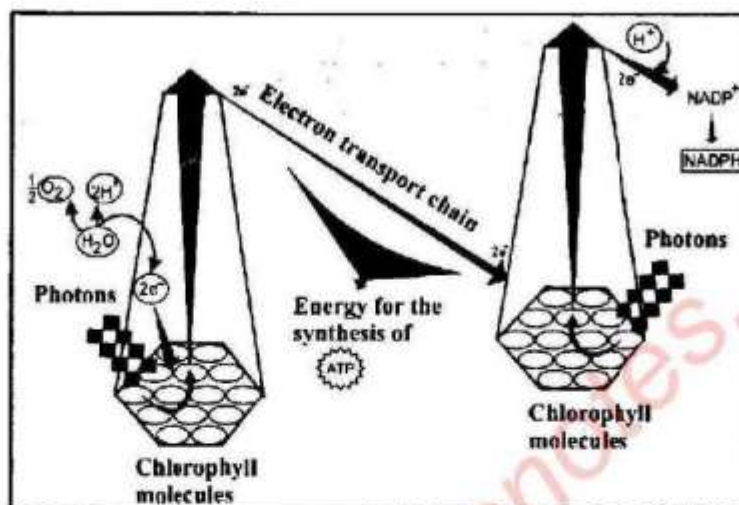
The summary of the events of light reactions is as follows;

i. When chlorophyll molecules absorb light, their energy level increases and their electrons are emitted (خارج ہوتے ہیں).

ii. Electrons are passed to electron transport chain to produce ATP.

iii. Light also breaks water molecule (photolysis) and oxygen is released. The hydrogen atoms of water give electrons to chlorophyll and become ions.

iv. The electrons of chlorophyll, after the production of ATP, and the hydrogen ions of water are used for the reduction $NADP^+$ into the NADPH.

The whole series of reactions (ردعمل کا سلسلہ) is called as **Z-scheme** due to its Z-shaped flow chart.

Light reactions of photosynthesis

Dark Reactions (Calvin Cycle):

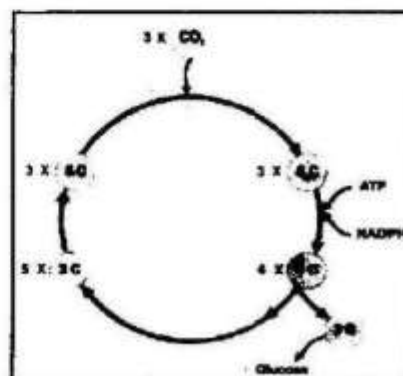
Dark reactions occur as readily (تیزی سے) in the absence (عدم موجودگی) of light as in its presence (موجودگی), as long as ATP and NADP are available. The details of dark reactions were discovered by **Malvin Calvin** and his colleagues at the University of California. Calvin was awarded Nobel Prize, in 1961, for his work on the details of photosynthesis.

The summary of the events of dark reactions, also known as Calvin cycle is as follows:

i. Carbon dioxide molecules are combined with 5-carbon compounds (مرکبات) to form temporary 6-carbon compounds, each of which splits (تقسیم ہوتا ہے) into two 3-carbon compounds.

ii. The 3-carbon compounds are reduced to 3-carbon carbohydrates by using ATP and hydrogen from NADPH. The 3-carbon carbohydrates are used to manufacture glucose.

iii. The 3-carbon carbohydrates are also used to regenerate (دوبارہ پیدا کرنا) the original 5-carbon compound. This steps also utilizes ATP.

In dark reactions, 3-carbon compounds are reduced to form carbohydrates. Hydrogen for this reduction is supplied by $NADPH_2$.

Dark reactions of photosynthesis
(The Calvin cycle)

7.2.2 ROLE OF CHLOROPHYLL AND LIGHT

Q.5. What is the role of chlorophyll and light in photosynthesis?

Ans: Role of Chlorophyll and Light:

Sunlight energy is absorbed (جذب ہو جاتی ہے) by chlorophyll. It is then converted into chemical energy, which drives the photosynthetic process.

Only about one percent (ایک فی صد) of the light falling on the leaf surface (پتے کی سطح پر) is absorbed, the rest is reflected or transmitted.

The light rays of different wavelengths are not only differently absorbed by photosynthetic pigments (رنگدار مادے) but are also differently effective in photosynthesis.

When chlorophyll absorbs light, its electrons are excited and they leave chlorophyll molecule. The excited electrons are passed through electron transport chain and their energy is captured for the formation of ATP and for reducing NADP to NADPH.

Pigments are the substances that absorb visible (دکھائی دینے والی) light. Different pigments absorb light of different wavelengths (colours). The photosynthetic pigments are organized in the form of clusters (جھنڈ), called photosystems, in thylakoid membranes of chloroplasts.

Chlorophyll-a is the main photosynthetic pigment. Others are called accessory (اضافی) pigments and include chlorophyll-b and carotenoids.

Chlorophyll absorbs mainly blue and red lights. Some wavelengths not absorbed by chlorophyll 'a' are very effectively absorbed by accessory pigments and vice-versa.

7.2.3 LIMITING FACTORS IN PHOTOSYNTHESES

Q.6. State how the varying light intensity, carbon dioxide concentration and temperature affect the rate of photosynthesis.

Ans: Limiting Factor:

Any environmental factor (ماحولیاتی عامل) the absence or deficiency of which can decrease the rate of a metabolic reaction, is called limiting factor for that particular reaction.

Limiting factors in Photosynthesis:

Many factors in the surrounding environment act as the limiting factors for photosynthesis. Important limiting factors of photosynthesis are:

1. Light intensity
2. Temperature
3. Concentration (ارتکاز) of carbon dioxide
4. Availability of water also act as a limiting factor.

Effect of light intensity:

The rate of photosynthesis varies (مختلف ہوتا ہے) with light intensity. It decreases as the light intensity decreases and increases as the intensity increases. However at much higher

light intensity, the rate of photosynthesis becomes constant.

Effect of temperature:

The rate of photosynthesis decreases with decrease in temperature. It increases as the temperature is increased over a limited range. But if light intensity is low, increasing the temperature has little influence (اثر) on the rate of photosynthesis.

Effect of carbon dioxide concentration:

As carbon dioxide concentration rises, the rate of photosynthesis goes on increasing until limited by other factors. Increase in carbon dioxide concentration beyond a certain level causes the closure (بندش) of stomata and it decreases the rate of photosynthesis.

Effect of Available Water:

Free availability of water increases the rate of photosynthesis as water is the source (ذریعہ) of hydrogen atom for the molecule of glucose.

PRACTICAL WORK

Demonstration (مظاہرہ) of photosynthesis:

The phenomenon of photosynthesis can be demonstrated by using an aquatic plant (آبی پودا), like *Hydrill*. You know that in the process of photosynthesis, oxygen gas is evolved as a by-product. So release of oxygen from a set up would provide an evidence (ثبوت) of photosynthesis.

Problem: Does *Hydrilla* carry out photosynthesis when provided by all the essential factors?

Hypothesis:

Hydrilla is an aquatic plant carries out photosynthesis, using CO_2 and water and releases oxygen at the same time.

Deduction:

Release of O_2 from the plant body would be a proof of photosynthesis.

Material required:

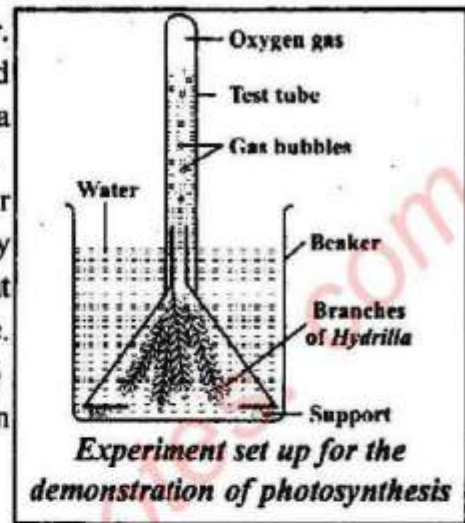
Fresh *Hydrilla* branches, 500 ml beaker, funnel, test tube, potassium bicarbonate, match box, water tub.

Background information:

Carbon dioxide and water are the raw materials for photosynthesis. When potassium bicarbonate is dissolved (حل ہو جاتا ہے) in water, it is ionized into carbonate and hydrogen ions. The carbonate ions release carbon dioxide.

Procedure:

1. Fill about half of the 500-ml beaker with water.
2. Take some fresh branches of *Hydrilla* and place them in the broader side (چوڑی سمت) of a funnel (قیف) and set the funnel as shown in fig.
3. Put an inverted (الٹی) test tube on the tubular part of the funnel. (Perform step 1,2 and 3 by putting all the apparatus in a water tub, so that no external (بیرونی) air would enter the test tube. After step 3, bring the set-up out of water tub.)
4. Put some quantity of potassium bicarbonate in the water of beaker.
5. Put all the set up in light and observe.

Experiment set up for the demonstration of photosynthesis

Observation: Bubbles (بلبلے) would be created in test tube water and these will accumulate (جمع ہوں گے) in the top portion of the tube.

Results: The branches have released oxygen gas in the form of bubbles.

Confirmation: When enough gas bubbles have accumulated in the test tube, pick up the tube by putting thumb on its mouth. Take a burning match-stick (جلتی ہوئی دیا سلائی) inside the tube. It flares (تیزی سے جلتی ہے) up when it touches gas bubbles. It confirms that the test tube contains oxygen gas.

Error analysis: The experimental work would not give the expected results if any of the limiting factors of photosynthesis i.e. light, CO_2, water, and chlorophyll are not present. Similarly, if gas bubbles are not observed the branches used may be dead and decayed (خراب ہو چکی ہوں گی).

Evaluation:

(i) There are two phases of photosynthesis i.e. light reactions and dark reactions. During which of these phases oxygen is produced?

Ans. Oxygen is produced in the light reaction of photosynthesis.

(ii) Why was it necessary to do experiment with fresh branches of Hydrilla?

Ans. Fresh branches (تازہ شاخیں) of hydrilla are used in experiment because chorloplast is present in proper percentage.

(iii) Why did you use a burning match-stick for confirmatory test?

Ans. A burning match-stick is used for confirmatory test because oxygen helps in burning.

(iv) What products (other than oxygen) are produced during photosynthesis?

Ans. oxygen, glucose and energy is produced during photosynthesis.

PRACTICAL WORK

Investigation (تفتیش) for the presence of starch:

We know that in the process of photosynthesis, plants synthesize glucose by reducing CO_2 and for this reduction hydrogen is obtained from water. In many plants the synthesized glucose is converted into starch. So presence of starch in a leaf (پتہ) confirms that the plant has carried out photosynthesis. The presence of starch is investigated through starch test.

Problem: How would it be proved that starch is present in a leaf?

Hypothesis: A fresh leaf has carried out photosynthesis and has accumulated starch in its cells.

Deduction: If the experimental leaf is processed for starch test, it would give positive results for starch.

Material required: Fresh leaves, a 500 ml beaker, a forceps, a test tube, ethanol, dilute iodine solution, dropper, petri dish.

Background information:

- When a leaf is dipped in boiling water (ابلتا ہوا پانی) for sometime, it is killed and becomes soft.
- A soft and decolourized leaf can be tested in starch test. When soft leaf is boiled in ethanol it loses chlorophyll but retains starch in it.
- Starch turns blue when treated with dilute iodine solution (Fig below).

Procedure:

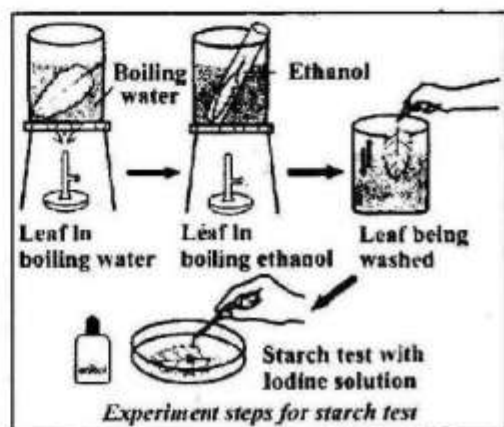
1. Dip a leaf in a beaker of boiling water for about ten seconds.
2. Take the leaf out of boiling water and put it in a test tube of ethanol.
3. Put the test tube in a beaker of hot water for ten minutes. The ethanol starts boiling and the leaf in it gets decolourized (رنگ خراب ہو جاتا ہے).
4. Wash the leaf by moving it up and down in water in a beaker and put the washed leaf in a petri dish.
5. Perform starch test with the leaf. It is done by putting drops of iodine solution on the leaf.

Experiment steps for starch test

Observation: Leaf will turn blue-black.

Results: Leaf contains starch.

Error analysis: If leaf is retained (رکھا جاتا ہے) in boiling water for long, it breaks the starch molecules

present in it. Such a leaf will not give the

expected results of the starch test.

Evaluation:

i. **From where did the leaf get starch?**

Ans. Glucose is formed in leaves during photosynthesis. Plants change this glucose into starch to store it.

ii. **Why was leaf placed in ethanol?**

Ans. Leaf is placed in ethanol to make it colourless and flaccid, to discharge all chlorophyll.

iii. **What was the purpose (مقصد) of washing the leaf before performing the starch test?**

Ans. To remove all dust particles leaf was washed before performing the starch test.

PRACTICAL WORK

Investigation to find out that chlorophyll is necessary for photosynthesis:

Chlorophyll is present in the chloroplasts of mesophyll cells. Leaves which lose their chlorophyll due to some diseases or salt deficiencies (کمی), fail to perform photosynthesis and eventually die.

Problem: Is chlorophyll necessary for photosynthesis?

Hypothesis: Chlorophyll is necessary for photosynthesis.

Deduction: There will be no photosynthesis in the parts of the leaf that do not have chlorophyll and so there will be no starch production in these parts.

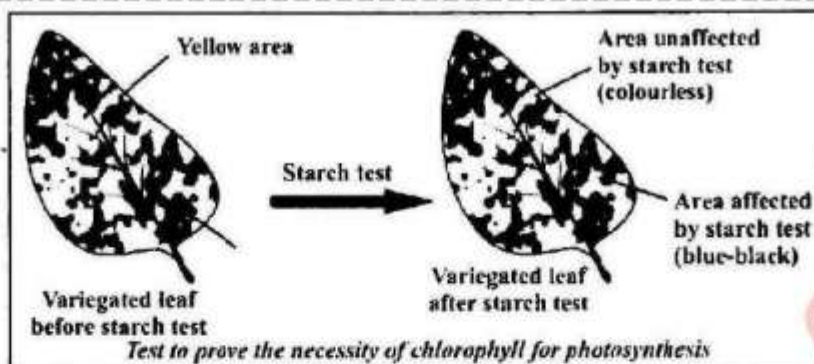
Material required: A variegated leaf e.g. leaf of *Geranium*, a 500 ml beaker, a forceps, a test tube, ethanol, dilute iodine solution, dropper, petri dish.

Background information:

- Some leaves have yellow areas on their green surface. These areas mark the absence of chlorophyll (chloroplasts) containing cells. Such spotted leaves are called variegated leaves.
- Occurrence (موجودگی) of photosynthesis can be confirmed by the presence of starch, through starch test.

Procedure:

1. Take a potted plant with variegated leaves e.g. *Geranium*.
2. Put the potted plant in light for several days so that it carries out photosynthesis (Fig below).
3. Detach (علیحدہ کر لیں) one of the variegated leaves and draw its upper surface on paper. The drawing should clearly distinguish the green and non-green areas.
4. Perform starch test on whole leaf.

Test to prove the necessity of chlorophyll for photosynthesis

Observation: The green parts of leaf will turn blue-black while the non-green parts will remain colourless (بےرنگ).

Results: There is no starch present in the non-green parts of leaf. In other words, these non-green parts do not carry out photosynthesis.

Error analysis: If non-green as well as green parts of leaf do not show the presence of starch, it means that the potted plant did not get any of the other required variables e.g. light, CO_2, water etc.

Evaluation:

i. **If there is no photosynthesis in the non-green parts of leaf, how they are alive?**

Ans. If there is no photosynthesis in non-green plants, then they used stored and prepared food to live.

ii. **In which phase of photosynthesis, chlorophyll plays its role?**

Ans. Chlorophyll absorbs light in photosynthesis and emits electrons. These electrons are used to form ATP.

iii. **Chlorophyll-a is the principal pigment. What are the accessory pigments?**

Ans. Chlorophyll- b and carotenoids are the accessory pigments.

PRACTICAL WORK

Investigation to find out that light is necessary for photosynthesis

Light energy is used for exciting the electrons of chlorophyll which in turn produce ATP and are also used for the reduction of CO_2. Thus light energy is incorporated in glucose in the form of bond energy.

Problem: Is light necessary for photosynthesis?

Hypothesis: Light is necessary for photosynthesis.

Deduction: There will be no photosynthesis in the parts of leaf that do not get sufficient light and so there will be no starch production in these parts.

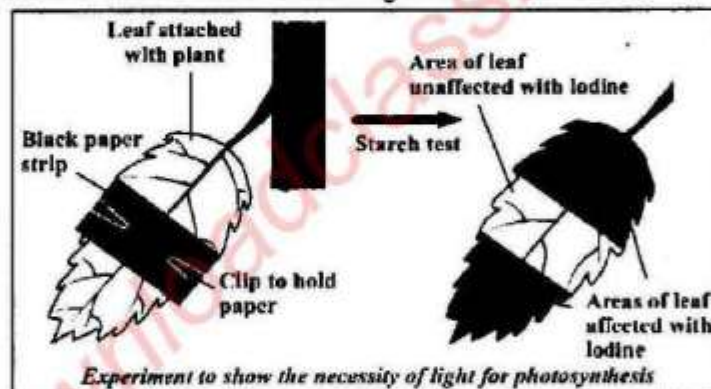
Apparatus required: A potted plant with healthy (صحت مند) leaves, black paper, paperclips, a 500 ml beaker, a forceps, a test tube, ethanol, dilute iodine solution, dropper, petri dish.

Background information:

- If a plant is kept in darkness (اندھیرا) for several days, it utilizes its stored starch and is said to be de-starched.
- Black paper can check the light falling on a leaf.
- Occurrence of photosynthesis can be confirmed by the presence of starch, through starch test.

Procedure:

1. Take a potted plant and keep it in darkness for at least three days so that its leaves are de-starched.
2. Attach a strip of black paper to both the upper and lower sides of a leaf as shown in Figure below.
3. Put the potted plant in a well-lit (روشن) place for at least five hours.
4. Remove the experimental leaf and perform the starch test to observe the presence and/or absence of starch. Make a drawing to show the results.

Experiment to show the necessity of light for photosynthesis

Observation: The part of the leaf having black paper strip will remain colourless while the other parts will turn blue-black.

Results: There is no starch present in the parts of leaf, which were covered by black paper. In other words, these parts did not carry out photosynthesis.

Error analysis: If the covered parts (چھپائے ہوئے) show the presence of starch, it means that the plant could not be de-starched while it was kept in darkness. It may be due to the reason that plant was not given enough (کافی) time to consume its stored starch.

Evaluation:

i. If light is necessary for photosynthesis, why the other parts of the plant do not photosynthesize, which receive light?

Ans. Chlorophyll is also necessary in photosynthesis with light.

ii. What adaptations leaves possess for maximum absorption of light?

Ans. Arrangement of leaves on branches epidermis, stomata and mesophyll.

iii. Which colours of light are least absorbed (کم سے کم جذب کیے جاتے ہیں) by the leaves?

Ans. Green colour is least absorbed by leaves.

PRACTICAL WORK

Investigation to find out that CO_2 is necessary for photosynthesis

In photosynthesis, CO_2 is reduced to form carbohydrates (glucose). Water acts as the hydrogen source for this reduction while sunlight is the energy source for it. Plants get CO_2 from air which enters in their leaves through stomata.

Problem: Is carbon dioxide necessary for photosynthesis?

Hypothesis: Carbon dioxide is necessary for photosynthesis.

Deduction: There will be no photosynthesis in the parts of leaf that do not get carbon dioxide and so there will be no starch production in these parts.

Apparatus required: A potted plant with healthy leaves, a 500 ml beaker, a forceps, a test tube, ethanol, dilute iodine solution, dropper, petri dish, potassium hydroxide solution, a glass flask with rubber cork.

Background information:

- If a plant is kept in darkness for several days, it utilizes its stored starch and is said to be de-starched.
- Potassium hydroxide absorbs CO_2 from its surroundings.
- Occurrence of photosynthesis can be confirmed by the presence of starch, through starch test.

Procedure:

1. Take a potted plant and keep it in darkness for at least three days so that its leaves are de-starched.
2. Take potassium hydroxide solution in a glass flask and fit a cork in the mouth of the flask. The cork should be cut longitudinally (لمبائی کے رخ پر) before fitting.
3. Select a leaf of the de-starched plant (but do not remove it from plant). Pass (گزاریں) half of the leaf from the cut of cork so that half portion (آدھا حصہ) of leaf is inside flask and other half is outside (Fig below).
4. Put the potted plant ilia well-lit at a place for at least five hours.
5. Remove the experimental leaf and perform starch test to observe the presence and/or absence of starch. Make a drawing to show the results.

Observation: The portion of leaf present inside flask will remain colourless while the other portion that remains in fresh air will turn blue-black.

Results: Carbon dioxide present in the air inside flask was absorbed by KOH and so the portion of leaf present here could not carry out photosynthesis and could not make starch.

Error analysis: If the portion of leaf inside flask shows the presence of starch, it means that the cut in the rubber cork was wide (چوڑا) to allow some air to enter the flask.

Evaluation:

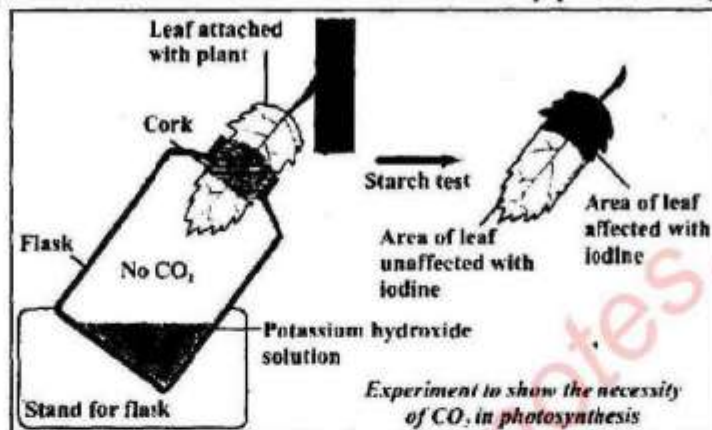
i. Why the portion inside the flask could not make starch?

Ans. The portion inside the flast could not make starch because there is no CO_2 in the

flask.

ii. Where had the CO_2 gone that was present in the air inside flask?

Ans. The CO_2 present in the air inside flask is absorbed by potassium hydroxide (KOH).

Experiment to show the necessity of CO_2 in photosynthesis

7.3 RESPIRATION

Q.7. Define cellular respiration. What do you mean by aerobic and anaerobic respiration?

Ans: Cellular Respiration:

Organisms utilize (استعمال کرتے ہیں) oxygen for the breakdown of C-H bonds present in the food in their cells. This breakdown yields (خارج کرتی ہے) energy which is transformed into ATP. During this process the C-H bonds are broken by oxidation- reduction reaction and so carbon dioxide and water are also produced. The cellular energy-yielding process is called cellular respiration.

The most common fuel (ایندھن) used by the cell to get energy by cellular respiration is glucose. The way glucose is oxidized depends on the availability of oxygen.

Aerobic And Anaerobic Respiration:

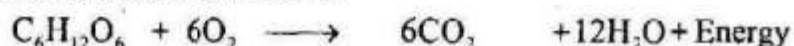
The cellular respiration occurring in the presence of oxygen is called aerobic respiration while the one that occurs in the absence of oxygen is called anaerobic respiration.

i. Aerobic Respiration:

In the presence of oxygen, complete oxidation of glucose occurs with maximum (زیادہ سے زیادہ) release of energy. In the first phase of aerobic respiration, a molecule of glucose (6-C) is broken down into two molecules of pyruvic acid (3-C) and in the second phase, molecules of pyruvic acid are completely oxidized (all C-H bonds are broken) to CO_2 and water and all the energy is released.

The overall reaction is as follows.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 12H_2O + \text{Energy}$$

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon dioxide} + \text{water} + \text{Energy}$$

ii. *Anaerobic Respiration (Fermentation):*

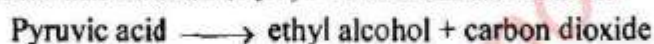
In the absence of oxygen, glucose is incompletely (نامکمل) oxidized with less amount of energy released. In anaerobic respiration, the first phase is exactly similar to that of aerobic respiration.

In first phase, a molecule of glucose is broken down into two molecules of pyruvic acid. But in the second phase, pyruvic acid is not completely oxidized (due to the absence of oxygen). It is transformed into ethyl alcohol or lactic acid. In this way many of the C-H bonds are left unbroken in the products.

Anaerobic respiration is further classified (درجہ بندی) as;

A-Alcoholic Fermentation:

It occurs in bacteria and yeast, etc. In this type of anaerobic respiration, pyruvic acid is further broken down into alcohol (C_2H_5OH) and carbon dioxide.

$$\text{Pyruvic acid} \longrightarrow \text{ethyl alcohol + carbon dioxide}$$

B-Lactic acid Fermentation:

It occurs in skeletal muscles of humans and other animals during extreme physical (جسمانی) activities when oxygen cannot be transported to the cells as rapidly as it is needed. This also happens in the bacteria present in milk. In this type of anaerobic respiration, each pyruvic acid molecule is converted into lactic acid ($C_3H_6O_3$).

$$\text{Pyruvic acid} \longrightarrow \text{Lactic acid}$$

Importance (اہمیت) of anaerobic respiration (fermentation):

1. When life evolved on Earth, the early land or water habitats did not have and supply of free (آزاد) oxygen (O_2). In these anaerobic conditions, early organisms respired anaerobically and got energy for their life activities.
2. Even today (آج بھی) when free oxygen is available, some organisms including some bacteria and some fungi get energy from anaerobic respiration and are called anaerobes. Humans can also provide energy to their skeletal muscle cells through anaerobic respiration. It happens when skeletal muscles have to work hard (during exercise etc.) but oxygen supply cannot be increased to fulfill the demand.
3. Scientists have used the fermenting abilities of fungi and bacteria for the benefit (فائدہ) of mankind (انسانیت). For examples, the fermenting powers of bacteria are used for making cheese (پنیر) and yogurt (دہی).
4. Fermentation in yeasts is used in brewing and baking industries.
5. The soy sauce is made through the fermentation by a fungus Aspergillus.

7.3.2 MECHANISM OF RESPIRATION

Q.8. Outline the mechanism of respiration while defining glycolysis, Krebs cycle and electron transport chain.

Ans: The process of respiration involves complex (پیچیدہ) series of reactions. Aerobic

respiration is a continuous (مسلسل) process, but for convenience (آسانی کے لیے) we can divide it into three main stages:

1. Glycolysis 2. Krebs cycle 3. Electron transport chain

1. *Glycolysis:*

Glycolysis occurs in the cytoplasm and oxygen is not involved (ملوث نہیں) at this stage. That is why, it occurs in both types of respiration i.e. anaerobic and aerobic. In glycolysis, glucose (6C) molecule is broken into two molecules of pyruvic acid (3C).

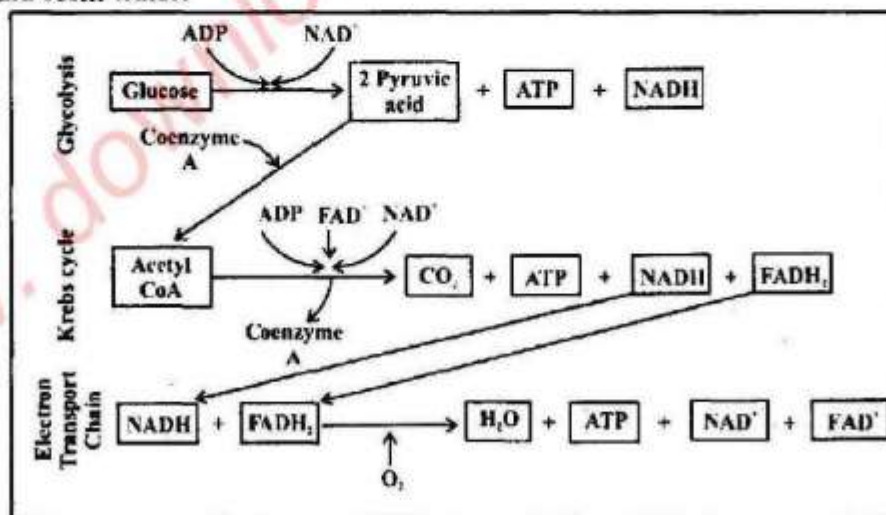
2. *Krebs Cycle:*

A British (برطانوی) biochemist, Sir Hans Krebs discovered this series of reactions that is why it is called the Krebs cycle.

In Krebs cycle, the pyruvic acid molecules are completely oxidized along with the formation of ATP, NADH and $FADH_2$. Before entering in Krebs cycle, pyruvic acid is changed into a 2-carbon compound called acetyl-CoA.

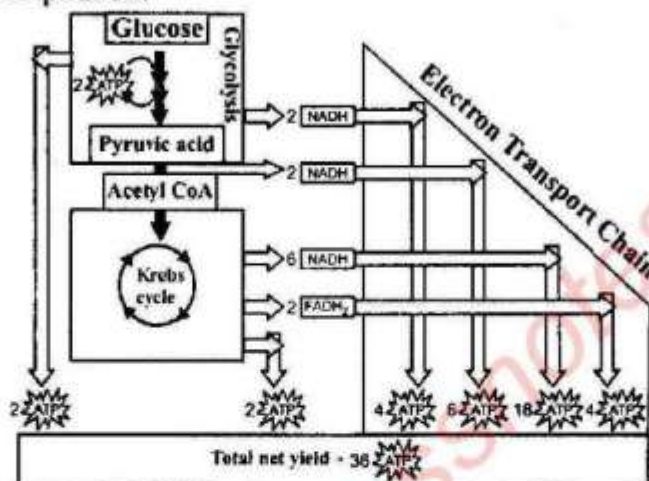
3. *Electron Transport Chain:*

The final step (آخری عمل) of cellular respiration is the transfer of electron on an electron transport chain. In this step, the energy carried by electrons is used to synthesize ATP.

In electron transport chain NADH and $FADH_2$ release electrons and hydrogen ions. These electrons are taken up by a series of electron carriers. When electrons move through the series of electron carriers they lose energy, which is used to synthesize ATP molecules. At the end of the chain electrons and hydrogen ions combine with molecular oxygen and form water.

The Energy Budget of Aerobic Respiration:

Each NADH molecule produces three ATP molecules in electron transport chain. While each NADH generated in glycolysis gives profit (نفع دیتا ہے) of two ATP molecules because it has to be transported across the mitochondrial membrane and it costs one ATP. Each $FADH_2$ molecule produces two ATP molecules.

The Energy Budget of Anaerobic Respiration:

During anaerobic oxidation of a glucose molecule only 2 ATP molecules are gained (حاصل ہوتے ہیں) as the net profit. It is because there is no Krebs cycle and electron transport chain in anaerobic respiration.

Energy chart of respiration

PRACTICAL WORK

Investigation to find out that carbon dioxide is released during aerobic respiration:

In aerobic respiration, the C-H bonds of glucose are broken. The hydrogen released in this breakage (ٹوٹنا) is taken by oxygen to produce water and CO_2 is left behind.

Problem: Does the process of respiration produce CO_2?

Hypothesis: CO_2 is produced as one of the end products of aerobic respiration.

Deduction: An organism carrying out aerobic respiration will release CO_2.

Apparatus required: Flasks, potassium hydroxide, lime water (چونے کا پانی), an animal.

Background information:

- Lime water readily absorbs CO_2.

Procedure: Set the apparatus as Figure below and observe the changes in lime water.

Observation: Color changes would be observed in lime water.

Experiment set up to investigate the release of carbon dioxide during aerobic respiration

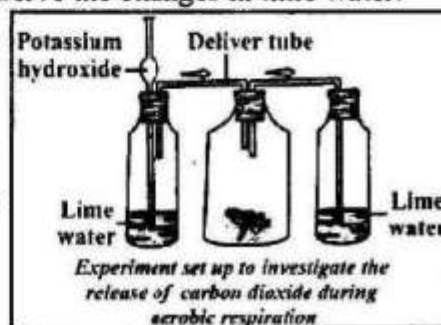
Results: CO_2 is produced during respiration.

Evaluation:

i. **What changes (تبدیلیاں) occurred in lime water?**

Ans. Colour is changed of lime water.

ii. **Why did we use potassium hydroxide and lime water?**

Ans. Potassium hydroxide and lime water are used by us because these react with CO_2

and change into carbonates.

PRACTICAL WORK

Investigation to find out that heat is given out (خارج ہوتی ہے) during aerobic respiration:

In respiration, lot of energy is released and some of this is stored in the form of ATP while the rest evolves out in the form of heat energy (حرارتی توانائی).

Problem: Is there any production of heat energy during respiration?

Hypothesis: Heat is produced during respiration.

Deduction: A thermometer placed in the apparatus where respiration is being carried out, would show a rise in temperature.

Apparatus required: Pea (مٹر) seeds (بیج), 01% chlorine or sodium hypochlorite solution, 02 beaker, 02 flasks, 02 thermometers, cotton.

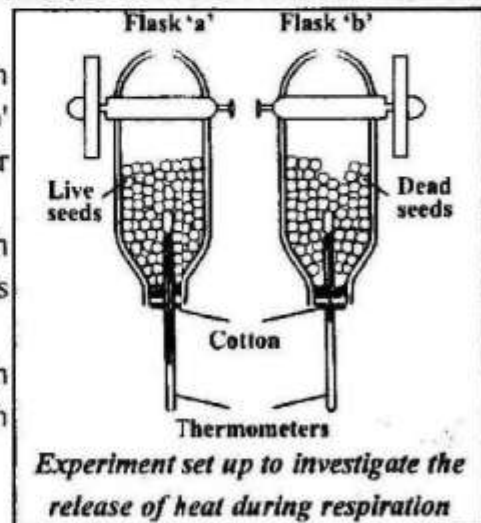
Background information:

- Seeds contain embryos of plants which consist of many cells (خلیے).
- Boiling of seeds kills their cells.
- High temperature causes decay of dead cells.

Procedure:

1. Take pea seeds and keep them in water for 24 hours.
2. Wash the seeds with some germicide (e.g. 01 % chlorine or sodium hypochlorite solution) to kill the bacteria present on their surface.
3. Boil some seeds for ten minutes so that their cells die. Cool these seeds so that these should not decay (خراب نہ ہو جائیں).
4. Put both sets of seeds (alive and dead) in separate flasks and label them as 'a and 'b' respectively. (Do not fill the flask up to their mouths.)
5. Insert a thermometer in the mouth of each flask and seal the mouth with cotton (روئی) as in Figure.
6. Invert (الٹ دیں) the flasks and fix them with stands and note the temperatures on both thermometers.
7. Keep the apparatus for about 4 hours.

Flask 'a' Flask 'b'
Live seeds Dead seeds
Cotton
Thermometers

Experiment set up to investigate the release of heat during respiration

Observation: The temperature reading in the thermometer put in flask 'a' rises but there is no rise in the temperature reading in the second thermometer.

Results: Respiration in the live cells of seeds in flask 'a' results in the release of heat.

Error analysis: If there is rise in temperature in the apparatus flask 'b", it may be due to some rise in room temperature. In such conditions, the temperature in flasks 'a' will raise

more than the temperature in flask 'b'.

Evaluation:

i. **Why were the flasks not filled up to their mouths (منہ تک)?**

Ans. Flasks were not filled up to their mouths to view or observe the changes of respiration.

ii. **Why did the temperature in flask 'a' rise and why did not in flask 'b'?**

Ans. Flask (a) has alive (زندہ) seed therefore the temperature is increased due to change in respiration. While flask (b) has dead leaf.

iii. **Is there any heat released during respiration in our bodies?**

Ans. Energy is produced during respiration which is used for different purposes (مقاصد).

Q.9. Draw a comparison of aerobic and anaerobic respiration.

Ans: ***Difference between aerobic and anaerobic respiration:***

Properties (خصوصیات)	*Aerobic respiration*	*Anaerobic respiration*
Presence of Oxygen	Yes	No
Number of ATP as net profit	36	O_2
Final products	CO_2, H_2O	Lactic acid of Ethanol + CO_2
Site of occurrence	Glycolysis in cytoplasm and Krebs cycle and electron transport chain in mitochondria	In cytoplasm
Importance	Major source of energy for most organisms	• Source of energy for anaerobic organisms. • Source of energy for aerobic organisms in short supply of CO_2 • Source of many products (ethanol, cheese etc)

Q.10. Write the differences between photosynthesis and respiration.

Ans: ***Difference between photosynthesis and respiration:***

Characteristics	*Photosynthesis*	*Respiration*
Metabolism	Anabolism	Catabolism
Energy investment/ production	Investment of light energy to store it in the form of bond energy	Bond energy transformed into chemical energy of ATP
Organisms capable of:	Some bacteria, all algae all plants	All organisms

Site of occurrence	Chloroplasts	In cytoplasm and mitochondria
Time of occurrence (وقت)	In daytime only, in the presence of light	All the time

Review Questions

MULTIPLE CHOICE

1. **In which of the following steps of respiration, CO_2 is produced?**
   (a) Glycolysis (b) Krebs cycle
   (c) Electron transport chain (d) All of these
2. **Oxygen takes part in aerobic respiration in:**
   (a) Glycolysis
   (b) Link step between glycolysis and krebs cycle
   (c) Krebs cycle (d) Electron transport chain
3. **When a plant was kept in darkness for many days, its leaves turned yellow. Why?**
   (a) Leaves could not get oxygen and so there was no photosynthesis
   (b) Leaves could not get light and so there was no respiration
   (c) Leaves could not get oxygen and so there was no respiration
   (d) Leaves could not get light and so there was no photosynthesis
4. **From which bonds of ATP molecule energy is taken?**
   (a) P-P bonds (b) C-H bonds (c) C-N bonds (d) C-O bonds
5. **In which component of the leaf cells, chlorophyll is present?**
   (a) Stroma (b) Thylakoids (c) Plasma membrane (d)Cytoplasm
6. **Which of these can enter into Krebs cycle?**
   (a) Glucose (b) Pyruvic acid (c) Citric acid (d) Acetyl Co-A
7. **When we work hard we suffer from muscle fatigue because muscle cells:**
   (a) Carry out aerobic respiration at faster rate and so are tired
   (b) Carry out anaerobic respiration and so accumulate more CO_2
   (c) Carry out anaerobic respiration and so accumulate lactic acid.
   (d) Carry out aerobic respiration and so accumulate lactic acid.
8. **How many molecules of CO_2 are produced when Krebs cycle operates once?**
   (a) 01 (b) 02 (c) 03 (d) 06
9. **In which of the following metabolic processes, oxidation as well as reduction of molecules occur?**
   (a) Photosynthesis (b) Respiration (c) Both (d) None of these
10. **Chlorophyll pigment absorbs maximum light in wavelengths of:**
    (a) Green and blue (b) Green and red (c) Green only (d) Red and blue

Ans: **1.** Krebs cycle **2.** Electron transport chain
3. Leaves could not get light and so there was no photosynthesis
4. P-P bonds **5.** Thylakoids **6.** Acetyl Co-A
7. Carry out anaerobic respiration and so accumulate lactic acid **8.** 03
9. Both **10.** Red and blue

UNDERSTANDING THE CONCEPTS

1. How would you define bioenergetics while relating it to the oxidation reduction reactions in living systems?

Ans: Refer to Q.No.1 for answer.

2. Interpret that ATP is the chief energy currency of all cells.

Ans: Refer to Q.No.2 for answer.

3. What is the role of chlorophyll and light in photosynthesis?

Ans: Refer to Q.No.5 for answer.

4. Outline the processes involved in photosynthesis.

Ans: Refer to Q.No.4 for answer.

5. State how the varying light intensity, carbon dioxide concentration and temperature affect the rate of photosynthesis.

Ans: Refer to Q.No.6 for answer.

6. Outline the mechanism of respiration while defining glycolysis, Krebs cycle and electron transport chain.

Ans: Refer to Q.No8 for answer.

7. Draw a comparison of aerobic and anaerobic respiration.

Ans: Refer to Q.No.9 for answer.

8. How will you compare respiration and photosynthesis?

Ans: Refer to Q.No.10 for answer.

SHORT QUESTIONS

1. Why is it said that all life forms are dependent on photosynthesis?

Ans: Photosynthesis is the manufacturing of glucose with oxygen as a by-product from carbon dioxide and water in the presence of sunlight and chlorophyll. All life depends on photosynthesis.

2. What structures and phenomena are involved in the intake of carbon dioxide and water by plants?

Ans: Uptake of water:

Water and salts are absorbed by the root hairs. Water enters from the soil into the

root hairs by osmosis and enters in the inner cells of the root and eventually reaches xylem vessels, which transport water to the leaves using the force of transpiration pull.

Uptake of carbon dioxide:

The air, carrying carbon dioxide, enters the leaf through tiny pores (stomata) by diffusion and enters into the air spaces present around mesophyll cells. Air gets absorbed in the thin layer of water surrounding the mesophyll cells. From here the carbon dioxide diffuses into the mesophyll cells.

3. *In what ways the respiratory energy is used in the body of organisms?*

Ans: The energy released by the process of respiration is utilized by different cellular activities such as cell division, reproduction, growth, development, metabolic activities, etc

4. *What is the importance of anaerobic respiration?*

Ans: Importance of anaerobic respiration (fermentation):

1. When life evolved on Earth, the early land or water habitats did not have and supply of free oxygen (O_2). In these anaerobic conditions early organisms respired anaerobically and got energy for their life activities.
2. Even today when free oxygen is available, some organisms including some bacteria and some fungi get energy from anaerobic respiration and are called anaerobes. It happens when skeletal muscles have to work hard (during exercise etc.) but oxygen supply cannot be increased to fulfill the demand.
3. Scientists have used the fermenting abilities of fungi and bacteria for the benefit of mankind. For examples, the fermenting powers of bacteria are used for making cheese and yogurt.
4. Fermentation in yeasts is used in brewing and baking industries.
5. The soy sauce is made through the fermentation by a fungus Aspergillus.

THE TERMS TO KNOW

Acetyl-CoA:

A compound formed by the combination of acetate with co-enzyme A.

Adenine:

Adenine is a double-ring nitrogenous base.

ADP:

Adenosine di phosphate, Formed of an adenine, ribose and two phospate groups.

Aerobic respiration:

Type of respiration which occurs in the presence of oxygen.

Alcoholic fermentation:

Alcoholic fermentation occurs in bacteria, yeast etc. In this type, pyruvic acid is

further broken down into alcohol and CO_2.

AMP:

Adenosine monophosphate, Formed of an adenine, ribose and one phosphate group.

Anabolism:

Anabolism includes the biochemical reactions in which larger molecules are synthesized.

Anaerobic respiration:

Type of respiration which occurs in the absence of oxygen.

ATP:

Adenosine triphosphate. The major energy currency of all cells in a nucleotide.

Autotrophic:

Such organisms which can prepare their food by themselves.e.g plants.

Bioenergetics:

Bionergetics is the study of energy relationships and energy transformations in living organisms.

Calvin cycle:

The summary of the events of dark reactions, also known as calvin cycle.

Chlorophyll:

The green pigment inside the chloroplasts of plant cells. It enables photosynthesis to take place.

Coenzyme-A:

Co-enzyme-A is an organic co-factor which is loosly attach with enzyme.

Electron transport chain:

Electron transport chain is the final step of cellular respiration.

FAD:

Flavin adenine dinucleotide (FAD) is a co-enzyme.

Glycolysts:

Break down of glucose is called glycolysis.

Krebs cycle:

In Kreb's cycle, the pyruvic acid molecules are completely oxidized, along with the formation of ATP, NADH and $FADH_2$.

Lactic acid fermentation:

In this type of anaerobic respiration, each pyruvic acid molecule is converted into lactic acid $(C_2H_6O_3)$

Light-dependent reactions:

Such reactions which need ligth for their completion are called light-dependent reactions.

Limiting factors:

Any Environmental factor the absence or deficiency of which can decrease the rate of a metabolic reaction, is called limiting factor for that reaction.

Mesophyll:

The leaf tissues specialized for photosynthesis.

Metabolism:

Metabolism is the set of biochemical reactions that occur in living organisms to maintain life.

NAD:

Nicotine-amide adenine dinucleotide. A co-enzyme used in oxidation-reduction reactions.

Oxidation:

The loss of electrons is called oxidation.

Photolysis:

A process in which complex substance are broken down with the help of light.

Photosynthesis:

Photosynthesis is the synthesis of glucose from carbon dioxide and water in the presence of sunlight and chlorophyll, with oxygen as a by-product.

Photosystem:

Photosynthesis pigments are organized in the form of clusters, called photosystems.

Pigments:

Pigments are the substances that absorb visible light.

Pyruvic acid:

Pyruvic acid is a molecule with 3-C. It is formed by the break down of glucose.

Reduction:

The gain of electrons is called reduction.

Respiration:

The process in which C-H bonds are broken by oxidation-reduction reaction and energy, CO_2 and water are produced.

Stroma:

In the chloroplast, grana floot in the inner fluid of chloroplast called stroma.

Thylakoid:

The inner membrane of chloroplast gives rise to sacs called thylakoid.

Z-scheme:

The whole series of light reactions is calld Z-scheme due to its Z-shaped flow chart.

INITIATING AND PLANNING

1. Design the molecular model of ATP using low-cost no-cost materials.
2. Design a model of light and dark reactions by low-cost no-cost materials.

ACTIVITIES

1. Demonstrate the process of photosynthesis using an aquatic plant, like *Hydrilla*.
2. Identify and label the cellular and tissue structures in the CS of a leaf through observation under the microscope.
3. Investigate the necessity of chlorophyll, light, carbon dioxide, using appropriate controls.
4. Demonstrate the process of respiration in germinating seeds by using limewater.
5. Investigate the release of carbon dioxide and heat during aerobic respiration in germinating seeds.

ON-LINE LEARNING

- en.wikipedia.org/wiki/Bioenergetics
- photoscience.la.asu.edu/
- www.sambal.co.uk/respiration.html
- www.fi.edu/learn/heart/system/respiration.html

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **How much ATP molecules are formed during Cellular Respiration?** **(LHR. GI)**
   (A) 40 (B) 38 (C) 63 (D) 36
2. **The Covalent bond connecting two phosphates is indicated by:** **(LHR. GII)**
   (A) Ratio (B) Proportion (C) Colon (D) Tilde
3. **ATP molecule was discovered in ________.** **(GRW. GI)**
   (A) 1829 (B) 1939 (C) 1929 (D) 1839
4. **Process of glycolysis is found in ________.** **(GRW. GII)**
   (A)ribosomes (B) cytoplasm (C) Golgi complex (D) vacuole

5. **One mole of ATP release energy:** (FBD. GI)
(A) 7.3 K.Cal (B) 7.4K.Cal. (C) 7.5K.Cal. (D) 7.6K.Cal.
6. **How much light is absorbed falling on the leaf surface?** (FBD. GII)
(A) 1% (B) 2% (C) 4% (D) 3%
7. **Chlorophylls absorb _______ type of light basically.** (MLN. GI & GII, SWL. GI)
(A) Green and blue (B) Red and yellow (C) Blue and red (D) Red and green
8. **Necessary for aerobic respiration:** (SWL. GII)
(A) carbon dioxide (B) oxygen (C) water (D) hydrogen
9. **Each ATP molecules has the number of sub units:** (SGD. GI)
(A) 2 (B) 3 (C) 4 (D) 5
10. **The greatest fuel of energy for cellular respiration is:** (RWP. GI, BWP. GI)
(A) Glucose (B) Protein (C) Amino acid (D) Lipids
11. **In which part of chloroplast, light reactions of photosynthesis take place?** (RWP. GII)
(A) Outer membrane (B) Inner membrane
(C) Stroma (D) Thylakoid membranes
12. **The lose of electron from atom is called:** (DGK. GI, GRW. GI)
(A) Reduction (B) Oxidation (C) Anabolism (D) Catabolism
13. **The energy currency of all the cells is called:** (BWP. GI)
(A) DNA (B) ATP (C) AMP (D) ADP
14. **By Product of Photosynthesis is:** (DGK. GI, BWP. GII)
(A) Water (B) CO_2 (C) Oxygen (D) Glucose
15. **How many molecules of CO_2 are produced when krebs cycle operates once?** (LHR. GII, MLN. GII)
(A) 1 (B) 2 (C) 3 (D) 6
16. **In which process oxygen is released as a bi product?** (GRW. GII)
(A) photosynthesis (B) respiration (C) fermentation (D) reproduction
17. **Number of carbon atoms in pyruvic acid is:** (FBD. GI)
(A) 03 (B) 07 (C) 09 (D) 30
18. **In which step of respiration carbondioxide is produced?** (FBD. GII)
(A) Kreb cycle (B) Electron transport chain (C) Glycolysis (D) In day time
19. **The energy currency of all cells is:** (SWL. GI)
(A) glucose (B) protein (C) ADP (D) ATP
20. **Nitrogenous base of ATP molecule is:** (SWL. GII)
(A) adenine (B) guanine (C) cytocine (D) thyamine
21. **In cell aerobic respiration sites are:** (SGD. GI)
(A) Golgi bodies (B) Mitochondria (C) Ribosomes (D) Chloroplast
22. **Through which process organisms gets energy?** (SGD. GI)
(A) Photosynthesis (B) Respiration (C) Transpiration (D) Evaporation

23. Number of phosphate groups in ATP molecule: (SGD. GII)
(A) One (B) Two (C) Three (D) Four

24. Aerobic respiration occurs in: (RWP. GI)
(A) Cytoplasm (B) Plastids (C) Lysosomes (D) Mitochondria

25. Sun light is absorbed by: (RWP. GII)
(A) Flower (B) Stem (C)-Chlorophyll (D) Leaves

26. The example of a nucleotide is: (DGK. GII)
(A) A.T.P (B) D.T.P (C) A.M.P (D) A.D.P

Answers

1. 36	2. Tilde	3. 1929	4. cytoplasm	5. 7.3 K.Cal
6. 1%	7. Blue and red	8. oxygen	9. 3	10. Glucose
11. Thylakoid membranes		12. Oxidation	13. ATP	14. Oxygen
15. 3	16. photosynthesis	17. 03	18. Kreb cycle	19. ATP
20. adenine	21. Mitochondria	22. Respiration	23. Three	24. Mitochondria
25. Chlorophyll	26. A.M.P			

☆ Give short answer to the following questions.

1. Define Light Reactions. (LHR. GI, SGD. GII)

Ans: Such reactions which need ligth for their completion are called light-dependent reactions.

2. What is Cellular Respiration? (LHR. GI, RWP. GI, BWP. GI & GII, FBD. GI)

Ans: Organisms utilize oxygen for the breakdown of C-H bonds present in the food in their cells. This breakdown yields energy which is transformed into ATP. During this process the C-H bonds are broken by oxidation- reduction reaction and so carbon dioxide and water are also produced. The cellular energy-yielding process is called cellular respiration.

3. ATP stand for. (LHR. GII)

Ans: ATP stand for adenosine triphosphate.

4. What is the effect of carbon dioxide concentration on photosynthesis? (GRW. GI, FBD. GI, SGD. GII)

Ans: As carbon dioxide concentration rises, the rate of photosynthesis goes on increasing until limited by other factors. Increase in carbon dioxide concentration beyond a certain level causes the closure of stomata and it decreases the rate of photosynthesis.

5. Describe the effect of a active site intensity of light on the speed of photosynthesis. (GRW. GII)

Ans: The rate of photosynthesis varies with light intensity. It decreases as the light intensity decreases and increases as the intensity increases. However at much higher light intensity, the rate of photosynthesis becomes constant.

6. Define aerobic and anaerobic respiration.
(FBD. GI & GII GRW. GII, SWL. GI, RWP. GII, BWP. GII, LHR. GI & GII, SGD. GI,)

Ans: Aerobic respiration: The type of respiration which occurs in the presence of oxygen is called Aerobic respiration.

Anaerobic respiration: That type of respiration which take place in absence of oxygen is called anaerobic respiration.

7. What is difference between oxidation and reduction?
(FBD. GI, MLN. GII, LHR. GII, SGD. GI, BWP. GII)

Ans: Oxidation: The loss of electrons is called oxidation.

Reduction: The gain of electrons is called reduction.

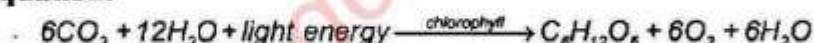
8. Define alcoholic fermentation. (FBD. GII, DGK. GI & GII)

Ans: Alcoholic fermentation occurs in bacteria, yeast etc. In this type, pyruvic acid is further broken down into alcohol and CO_2.

9. What is Photosynthesis? Write its chemical equation.
(MLN. GI, SWL. GI, SGD. GI LHR. GI, RWP. GI, BWP. GI & GII)

Ans: Photosynthesis is the synthesis of glucose with oxygen as a by-product from carbon dioxide and water in the presence of sunlight and chlorophyll. All life depends on photosynthesis.

Chemical equation:

$$6CO_2 + 12H_2O + light\ energy \xrightarrow{chlorophyll} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

10. Why is ATP considered as the energy currency of the cell? (MLN. GI, SWL. GII)

Ans: The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP).

The ability of ATP to store and release energy is due to its molecular structure.

11. What is ATP and who discover it? (SGD. GII)

Ans: The major energy currency of all cells is a nucleotide called adenosine triphosphate (ATP).

Discovery of ATP: ATP was discovered in 1929 by Karl Lohmann, and was proposed to be the main energy-transfer molecule in the cell by the Nobel Prize winner, Fritz Lipmann in 1941.

12. Give the full name of F.A.D. (DGK. GI, GRW. GI)

Ans: Flavin adenine dinucleotide (FAD) is a co-enzyme.

13. What is abbreviation of NAD? Where it is used? (DGK. GII)

Ans: NAD stands for Nicotine-amide adenine dinucleotide. A co-enzyme used in oxidation-reduction reactions.

14. What are Pigment and what is its colours in chlorophyll? (RWP. GII, DGK. GII)

Ans: Pigments are the substances that absorb visible light. Different pigments absorb light of different wavelengths (colours). The photosynthetic pigments are organized in the form of clusters, called photosystems, in thylakoid membranes of

chloroplasts.

15. What is kreb cycle? (LHR. GII)

Ans: The process in which pyruvic acid molecules are completely oxidized, along with the formation of ATP, NADH and $FADH_2$ is known as kreb cycle.

16. State the importance of Chlorophyll in plants. (RWP. GII, MLN. GI, FBD. GII)

Ans: Sun light energy is absorbed by chloroplyll. It is then converted into chemical energy, which drives the photosynthetic process only one percent of light falling on leaf surface is absorbed, the rest is reflected or transmitted.

Light rays of different wave lengths are not only differently absorbed by photosynthetic pigments but are also differently effective in photosynthesis. The blue and red lights carry out more photosynthesis.

17. Define Limiting Factors. Name the limiting factors in Photosynthesis. (RWP. GI, MLN. GII)

Ans: The environmental factor whose deficiency or absence decrease the rate of metabolic reaction is called limiting factor.

Following are limiting factors in photosynthesis light intensity, temperature and concentration of CO_2.

18. Write the chemical equation of Aerobic Respiration. (MLN. GII)

Ans: Chemical equation for aerobic respiration is

$$C_6H_{12}O_6+6O_2 \longrightarrow 6CO_2 \quad +12H_2O+Energy$$

19. What is glycolysis? Where does this reaction occur? (LHR. GII, BWP. GI, SWL. GI, GRW. GI & GII)

Ans: Break down of glucose molecule is called glycolysis.

This process is occur in cytoplasm.

20. What is the role of pigments in photosynthesis? (SWL. GII)

Ans: Those substance which absorb visible light are called pigments. Photosynthetic pigments are organized in the form of cluster known as photosystems. Chlorophyll is main photosynthetic pigment all these are used to absorb visible light which run the process of photosynthesis.

21. Which molecule is called energy currency of cell? Write name of its major parts. (SGD. GII)

Ans: ATP is called energy currency of cell. Each ATP molecules has three parts. A adenine a double ringed nitrogenous base. b) a ribose five carbon sugar and (c) three phosphate group in linear chain.

22. Define ATP. Write its function in cell. (DGK. GII)

Ans: The major energy currency of all cells is nucleotide called adenosine triphosphate.

It's main function is to store energy.

23. What is meant by Dark Reaction? (BWP. GI)

Ans: The series of reaction in photosynthesis, which occur in absence of light is called dark reaction.

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Chapter 08 NUTRITION

Major Concepts:

- **8.1-Mineral nutrition in plants**
- **8.2-Components of human food**
  - 8.2.1-Effects of water and dietary fibres
  - 8.2.2-Balanced diet
  - 8.2.3-Problems related to nutrition
- **8.3-Digestion in human**
  - 8.3.1-Human alimentary canal
  - 8.3.2-Role of liver
- **8.4-Disorders of gut**

Q.1. What is nutrition? Why nutrition is essential for organisms? Define nutrients. What are the types of nutrition?

Ans. Nutrition (تغذیت):

The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy is called nutrition.

Importance of nutrition:

Nutrition is essential for growth and energy and to function normally.

Nutrients (آتےکل غذائیں):

Nutrients are the elements and compounds that an organism obtains for energy or for the synthesis of new materials.

Types of nutrition:

There are two types of nutrition.

(i) Autotrophic (خودپرور) nutrition (ii) Heterotrophic (ناخودپرور) nutrition

(i) Autotrophic nutrition:

It is a type of nutrition in which organisms obtain water, carbon dioxide and minerals (معدنیات) from their environment (ماحول) and prepare their food which is then used for growth and energy.

(ii) Heterotrophic nutrition:

It is a type of nutrition in which organisms obtain their food from other organisms

and use it for growth and energy.

8.1 Mineral Nutrition in Plants

Q.2. What are micronutrients and macronutrients? What are their roles in plant life?

Ans: Plants have the most efficient (بہت مستعد) mechanisms for autotrophic mode of nutrition. Plants get carbon, hydrogen and oxygen from water and carbon dioxide. In addition to these element, plants also require mineral elements for various activities (سرگرمیاں) and structures.

Micronutrients:

The nutrients which are required in small quantities (مقداریں) are micronutrients.

Examples:

Iron, molybdenum, boron, chlorine, zinc etc.

Macronutrients:

The nutrients which are required in large quantities are called macronutrients.

Examples:

Carbon, hydrogen, oxygen, nitrogen, magnesium, potassium etc.

Roles (کردار) of micronutrients and macronutrients in plants life:

Roles of micro and macronutrients are presented in table.

If any one of these nutrients is not supplied, plants show abnormalities (غیر فطری) and do not grow normally.

Macro nutrients	*Role in plant life*
Phosphorus	Component of ATP, nucleic acids, and coenzymes, necessary for seed germination, photosynthesis, protein formation etc
Sulphur (گندھک)	Component of proteins, vitamins and enzymes
Calcium	Activates (متحرک کرتا ہے) enzymes, is a structural component of cell wall, influences water movement in cells
Potassium	• Regulates the opening and closing of the stoma. • Reduces water loss from the leaves.
Molybdenum	Component of the enzyme that reduces nitrates to ammonia, important in building amino acids
Boron	Important in sugar transport, cell division, and synthesizing certain enzymes
Copper	Component of several enzymes
Manganese	Involved in enzyme activity for photosynthesis, respiration, and nitrogen metabolism
Zinc	Required in a large number of enzymes

Chlorine	Involved in osmosis of water
Nickel	Required in a nitrogen metabolism
Iron (لوہا)	Necessary for photosynthesis, activates many enzymes.

Q.3: What are the roles of nitrogen and magnesium for plant?

Ans. NITROGEN:

Plants get nitrogen in the form(شکل) of nitrates.

Role of nitrogen in plant life:

1. Nitrogen is a major component of proteins, hormones, chlorophyll, vitamins and enzymes essential (ضروری) for plant life.
2. Nitrogen metabolism is a major factor in stem(تنا) and leaf growth.

Excess of nitrogen:

Too much (بہت زیادہ) nitrogen can delay flowering and fruiting.

Deficiency of nitrogen:

Deficiency (کمی) of nitrogen can reduce yields(پیداوار), cause yellowing of the leaves and stunt (روکنا) growth.

MAGNESIUM:

1. Magnesium is a structural component of chlorophyll.
2. It is necessary for functioning of plant enzymes to produce carbohydrates, sugars and fats.

Use of magnesium:

Magnesium is used for fruit and nut(گٹھلی) formation and essential for germination of seeds.

Deficiency of magnesium:

Deficiency of magnesium causes yellowing and wilting(مرجھانا) of leaves.

Q.4. What are fertilizers (کھادیں)? How are the inorganic and organic fertilizers important in agriculture(زراعت)?

Ans: ***Fertilizers:***

Materials which are added to soil resulted in plant, with desirable characteristics (خاصیتیں) (e.g more fruit, faster growth, more attractive(پرکشش) flowers) are called fertilizers.

Classification (درجہ بندی) of fertilizers:

Fertilizers are broadly(جزئیات سے قطع نظر) classified as organic and inorganic fertilizers.

Inorganic fertilizer:

Definition:

Fertilizers which are first available from soil to the plant for uptake are inorganic fertilizers.

Explanation:

Naturally (قدرتی طور پر) occurring inorganic fertilizers include rock phosphate, elemental

sulfur, and gypsum, these are not chemically modified (کیمیائی طور پر تبدیل نہیں کیے ہوئے).

Nitrogen Fertilizer:

If in fertilizers nitrogen is the main element (بڑا عنصر), they are described as nitrogen fertilizers.

Solubility (حل پذیری) of inorganic fertilizers:

Most inorganic fertilizers dissolve (حل ہو جاتے ہیں) readily in water and are immediately available to plants for uptake.

Organic fertilizer:

Definition:

Fertilizers which take time to be broken down into forms usable by plants due to their complexity (پیچیدگی) are called organic fertilizers.

Natural organic fertilizers:

A natural organic fertilizer is the one that is derived (حاصل کیا جاتا ہے) from either plant or animal materials.

Examples: Manure (جانوروں کا فضلہ) and compost (گلی سڑی کھاد) are used as organic fertilizers.

Importance:

They can increase soil drainage, aeration (ہوا پیدا کرنا), and the ability of the soil to hold nutrients.

Q.5. What are the environmental hazards related to fertilizers use?

Ans: Environmental hazards related to fertilizers' use:

The fertilizers are useful in agriculture but they are also hazardous (نقصان دہ) for environment.

1. ***Reduce soil nutrient-holding capacity:***

The massive (بھاری) quantities of inorganic fertilizers affect the soil nutrient-holding capacity (صلاحیت).

2. ***Eutrophication:***

High solubilities of fertilizers degrade (کم کرتی ہیں) ecosystems through increase in chemical nutrients in an ecosystem. This is called eutrophication.

3. ***Emission (خارج ہونا) of nitrous oxide:***

Storage and application of some nitrogen fertilizers may cause emissions of the green house gas nitrous oxide (N_2O).

4- ***Emission of ammonia gas:***

Ammonia gas may be emitted from the inorganic fertilizers.

5. ***Increase the reproduction rate of pest (کیڑے):***

Excessive nitrogen fertilizers can lead to pest problems by increasing their reproduction rate.

Nutrient content of soil:

Nutrient content of soil and nutrient requirements of the crop (فصل) should be

carefully balanced by the application of inorganic fertilizers.

6. ***Many environmental problems:***

Excessive amounts of organic fertilizers cause environmental problems due to nitrate leaching (تقطیر کرنا) or run off of soluble organic compounds.

8.2 Major Component of food

Q.6. Draw a table that can show the sources (ذرائع), energy values and functions of carbohydrates, proteins and fats.

Ans:

	Sources	*Energy value*	*Functions*
Carbohy-drates	Bread, pastas (سویاں وغیرہ), beans, potatoes, bran (بھوسی), rice and cereals (اناج).	contain 04 kilocalories per gram	(i) These are the basic source of energy. ***Examples:*** Maltose, lactose, sucrose and starch.
Proteins	meat, eggs, grains, legumes (پھلیاں), milk and cheese.	contain 04 kilocalories per gram	(i) Essential component of muscles, ligaments (ریشے) and tendons (عضلات کے ریشے). (ii) These are used as enzymes (iii) These are components of cytoplasm, membranes and organelles. (iv) This is a source of energy.
Fats	milk, butter, cheese, eggs, mutton, fish, mustard seeds, coconut (ناریل) and dry fruits.	contains 09 kilocalories per gram.	(i) used to form membranes, the sheaths surrounding neurons, and certain hormones. (ii) These are extremely useful energy sources.

Q.7. Write detailed notes on following.

(i) Lipids (ii) Proteins

Ans. (i) Lipids:

Composition:

Lipids are composed of fatty acids bonded to glycerol.

Types of fatty acids:

Fatty acids of lipids are of two types.

(i) Saturated fatty acids (ii) Unsaturated (غیر سیراب شدہ) fatty acids

(i) Saturated (پوری طرح سیراب) fatty acids:

Saturated fatty acids have all of their carbon atoms bonded to hydrogen atoms.

Physical state (طبعی حالت) at room temperature:

Lipids containing saturated fatty acids are solid at room temperature.

Example:

Butter contains about 70% saturated fatty acids and 30% unsaturated fatty acids, so it is solid at room temperature.

Excessive (بہت زیادہ) use of saturated fatty acid:

If amount of saturated fatty acid increase in a human body, it will result in increase in cholesterol level. This increased cholesterol level may eventually result in clogging (بند) of arteries and ultimately, heart disease.

(ii) Unsaturated fatty acids:

Structurally they have some of their carbon atoms double-bonded in place of a hydrogen atom.

Physical state at room temperature:

Lipids containing unsaturated fatty acids are liquid at room temperature (کمرے کا درجہ حرارت).

Example:

Sunflower (سورج مکھی) oil contains about 75% unsaturated fatty acids. So, it is liquid at room temperature.

Source of energy:

One gram of lipids contains 09 kilocalories of energy.

Source of lipids:

Milk, butter, cheese, eggs, mutton, fish, mustard (رائی) seeds, coconut and dry fruits (خشک میوے) are important sources of lipids.

(ii) Proteins:

Composition:

Proteins are composed of amino acids.

Functions of proteins:

1. Proteins are essential components of the cytoplasm, membranes and organelles.
2. Proteins are the major components of muscles, ligaments and tendons.
3. Many proteins play role as an enzyme.
4. Proteins are the source of energy.

Amount of energy:

One gram of proteins contains 04 kilocalories of energy.

Sources of proteins:

Dietary sources of proteins are meat, eggs, grains, legumes, and dairy products such as milk and cheese (پنیر).

Q.8. Write detail and extensive notes on following.

(i) Minerals (ii) Carbohydrates

1. Minerals:

Minerals are inorganic elements.

Source:

Minerals originate (نکلتے ہیں) in the Earth and cannot be made in the body. Most of the minerals in human diet come directly (براہ راست) from plants and water, or indirectly from animal foods.

Importance of minerals:

Minerals play important roles in various body functions (جسمانی افعال) and are necessary to maintain health. Minerals interact with each other and with other nutrients.

Classification of minerals:

Minerals are mainly classified into two categories.

(i) Major minerals (ii) Trace minerals

(i) Major minerals:

Minerals that are required in amounts of 100mg (milligrams) or more per day.

(ii) Trace minerals:

Minerals which are required in amounts less than 100mg (milligrams) per day.

Roles of major and trace minerals in human body:

Role of major and trace minerals in human body are given below.

Minerals	*Role in body*	
Major menerals		
Sodium	Fluid balance in the body Helps in absorption of other nutrients	Important for muscle contraction (سکڑنا), nerve
Potassium	Fluid balance in the body Acts as cofactor for enzymes	impulse transmission, heart function and
Chloride	Fluid balance in the body Component of hydrochloric acid	blood pressure
Calcium	Development and maintenance of bones and teeth Blood clotting (خون کا جمنا)	
Magnesium & Phosphorus	Development and maintenance of bones and teeth	
Trace minerals		
Iron	Oxygen transport and storage	Act as enzyme
Zinc	Aids insulin action Helps in growth and reproduction	cofactors support immune function
Copper	Acts as enzyme cofactor	
Chromium	Helps in insulin action	
Fluoride	Stabilizes (مضبوط بناتا ہے) bone mineral and hardens tooth enamel	
Iodine	Essential for normal thyroid (غدہ) function	

(ii) Carbohydrates(نشاستے) :

Basic source of energy:

Carbohydrates are the basic source (بنیادی ذریعہ) of energy for all animals.

Major source of energy:

About half to $\frac{2}{3}$ of the total calories every animal consumes daily are from carbohydrates.

Some examples of carbohydrates:

⇒ Glucose is the most often (اکثر) used carbohydrate for energy.

⇒ Other useful carbohydrates are maltose, lactose, sucrose and starch.

Amount of energy:

Carbohydrates contain 04 kilocalories per gram.

Sources of carbohydrates:

Humans get carbohydrates from the foods like bread, pastas, beans, potatoes, bran, rice and cereals.

Q.9. How calcium and iron play vital (اہم) roles in human body? Describe briefly.

Ans: Calcium and iron are essential minerals which play vital role in human health.

Calcium:

Calcium is a major mineral.

Role in body:

(i) Calcium is essential for the development and maintenance of bones and teeth.
(ii) Calcium is needed for maintaining cell membranes and connective tissues.
(iii) It is used for activation of several enzymes.
(iv) It also aids in blood clotting.

Sources of calcium:

Humans get calcium from milk, cheese, egg yolk (انڈے کی زردی), beans, nuts, cabbage (گوبھی) etc.

Importance of calcium:

Good calcium nutrition along with low salt and high potassium intake, prevents, from hypertension and kidney stones.

Deficiency of calcium:

Deficiency of calcium causes.

(i) spontaneous (غیر ارادی) discharge of nerve impulses which may result in tetany (تشنج کے دورے).
(ii) bones become soft
(iii) blood clots slowly
(iv) wounds heal slowly.

Iron: Iron is a trace mineral.

Roles in body:

(i) Iron plays a major role in oxygen transport and storage.
(ii) It is a component of haemoglobin in red blood cells.
(iii) It is a component of myoglobin in muscle cells.
(iv) Iron is used as an enzyme cofactor in cellular respiration.
(v) Iron supports immune function.

Sources of Iron:

Humans get iron from red meat, egg yolk, whole wheat, fish, spinach (پالک), mustard etc.

Deficiency of Iron:

(i) Deficiency of iron causes anaemia (خون میں سرخ ذرات کی کمی).
(ii) Its deficiency is the most common nutrient deficiency worldwide (پوری دنیا میں).

Q.10. What are vitamins? How they are classified? How are vitamins A,C and D important in our diets?

Ans. VITAMINS (حیاتین):

Vitamins are chemical compounds (کیمیائی مرکبات) that are required in low amounts but are essential for normal growth and metabolism.

Classification of vitamins:

Vitamins may be divided into two groups.

(i) Water soluble (پانی میں حل پذیر) vitamins (ii) Fat (چربی میں حل پذیر) soluble vitamins

(i) Water soluble vitamins:

Cooking or heating readily destroys the water soluble vitamins. They also readily excrete (خارج ہونا) from the body. This means that levels of water-soluble vitamins in the body can decrease more quickly, leading to vitamin deficiency.

Examples: Vitamins B and vitamins C are water soluble vitamins.

(ii) Fat soluble vitamins:

Fat soluble vitamins remain much stable (مستحکم) while heating or cooking food. They also much less excrete from the body.

Example: Vitamins A,D,E and K are fat soluble vitamins.

Vitamin A:

Identification: Vitamin A was the first fat-soluble vitamin identified in 1913.

Role of vitamin A in our body: Vitamin A performs following functions.

(i) Vitamin A combines with a protein (لحمیات) called opsin to form rhodopsin in the rod cells of the retina of eye.
When vitamin A is inadequate, the lack of rhodopsin makes it difficult to see in dim light (کم روشنی).
(ii) It is involved in normal cell differentiation.

Cell differentiation:

It is a process through which embryonic cells transform into mature cells with specific functions.

Bone growth and immunity:

Vitamin A supports bone growth and immune (محفوظ کرنا) functions.

Sources of vitamin A:

Humans get vitamin A from leafy (پتوں والی) vegetables (spinach, carrots), yellow/orange fruits (mango), liver, fish, egg, milk, butter etc.

Deficiency symptoms of vitamin A:

(i) Blindness (اندھاپن):

Vitamin A is the leading cause of blindness in children world wide.

(ii) Night blindness (شب کوری):

One of the symptoms of vitamin A deficiency is **night blindness**. It is a temporary condition, but if left untreated it can cause permanent blindness.

(iii) Dry and damaged texture of skin:

Its deficiency also cause a condition in which hair follicles (تھیلی نما غدود) become plugged with keratin, giving dry texture to skin.

Vitamin C:

Vitamin C participates (شرکت کرتی ہے) in many reactions.

Roles of vitamin C in our body:

(i) Form collagen:

Vitamin C is needed to form collagen (a fibrous protein) that gives strength to connective (ملانے والے) tissues.

Use of collagen:

Collagen is also needed for the healing (آرام آنا) of wounds.

(ii) Immune system:

Vitamin C in white blood cells enables the immune system to function properly.

Sources of vitamin C:

Citrus fruits (ترشاوے پھل) (e.g. oranges, lemons, and grape fruit), leafy green vegetables, beef liver (گائے کا جگر) are best source of vitamin C.

Minute (بہت کم) quantities of vitamin C are present in muscles. Since meat consists of muscles so it is not a good source of vitamin C.

Deficiency symptoms of vitamin C:

(i) Connective tissues:

Deficiency of vitamin C causes connective tissue changes throughout the body.

(ii) Scurvy:

Deficiency of vitamin C results in scurvy (مسوڑھوں سے خون جاری ہونا) a disease in which synthesized collagen is unstable.

Symptoms of scurvy include muscle and joint pain, swollen (سوجے ہوئے) and bleeding gums, slow wounds healing, and dry skin.

Vitamin D:

Roles of vitamin D in our body are given below.

(i) ***Regulate calcium and phosphorous concentration:***

The best-known function of vitamin D is to help regulate blood levels of calcium and phosphorous.

(ii) ***Absorption (جذب کرنا) of minerals:***

Vitamin D increases absorption of these minerals from the intestine and their deposition (ذخیرہ کاری) in bones.

Sources of vitamin D:

(i) Vitamin D is mainly found in fish liver oil (مچھلی کے جگر کا تیل), milk, ghee, and butter etc.

(ii) It is also synthesized by the skin when ultraviolet (UV) radiations (شعاعیں) from the Sun are used to convert a compound into vitamin D.

Deficiency symptoms of vitamin D:

(i) ***Rickets in children:***

Long-term deficiency (کمی) of vitamin D affects the bones. In children, vitamin-D deficiency leads to **rickets**, a condition in which bones weaken and bow (جھک جانا) under pressure.

(ii) ***Osteomalacia in adults:***

In adults, vitamin-D deficiency causes osteomalacia, or soft bones. Osteomalacia increasing the risk for fractures in bones.

Q.11. Test a variety of food samples for the presence of starch, simple reducing sugars, proteins and lipids.

Ans: ***Material required:***

Reagents: Biuret reagent
Sudan red solution
Benedict solution
Iodine solution

Apparatus: Test tubes
Pipettes

Various items:

Milk, yogurt, cheese, meat, bread, table sugar, flour (آٹا), corn starch, various oils and fats, etc.

Test for starch:

Testing for the presence of starch is done through iodine solution, which changes from yellowish-brown to dark purple/black.

Procedure of iodine test:

1. Put on safety goggles (حفاظتی عینک) and a lab apron.
2. Select three clean test tubes.
3. With a wax pencil, label the tops of the test tubes 1,2 and 3.
4. (i) To test tube 1, add 40 drops of glucose
   (ii) To test tube 2, add 40 drops of starch
   (iii) To test tube 3, add 40 droops of water.
5. Add iodine solution to the three test tubes.

Observation: In test tube '2' a dark purple/black color will appear.

Result: Change in colour indicates (ظاہر کرتا ہے) a positive result for starch.

Test for simple reducing sugar:

Testing for simple carbohydrates (reducing sugars) is done through Benedict's solution. It is a blue colored liquid that contains copper ions.

When Benedict's solution and simple carbohydrates are heated, the solution changes to orange red/brick red (اینٹ جیسا سرخ).

Procedure of Benedict's test:

1. Get the three empty (خالی) test tubes.
2. Label the tops of test tubes 1,2 and 3.
3. (i) To test tube 1, add 40 drops of glucose.
   (ii) To test tube 2, add 40 drops of starch.
   (iii) To test tube 3, add 40 drops of water.
4. Add 10 drops of Benedict's solution to each test tube.

Observation:

The solution in test tube '1' will look blue and then it will make an orange to red-brick precipitate (رسوب).

Result:

(i) Change in colour indicates a positive result for reducing sugars.
(ii) Starch does not react positive with the Benedict's test unless they are broken down through heating.
(iii) Table sugar (disaccharide) is a non-reducing sugar and does not react with iodine and Benedict's solution.

Test for protein:

Testing for protein is done through Buiret test. Buiret solution is a blue liquid that changes to purple when proteins are present and to pink in the presence (موجودگی) of short chains of poly peptides.

Procedure of Biuret:

1. Select two clean test tubes.
2. With a wax pencil, label the tops of the test tubes 1 and 2.

3. (i) To test tube 1, add 40 drops of albumin solution (a protein)
   (ii) To test tube 2, add 40 drops of water.
4. Add 3 drops of Buiret solution to each test tube.

Observation: The solution in test tube '1' changes its colour to purple or pink.

Result: Change in colour indicates (ظاہر کرتا ہے) the presence of protein.

Test for lipids:

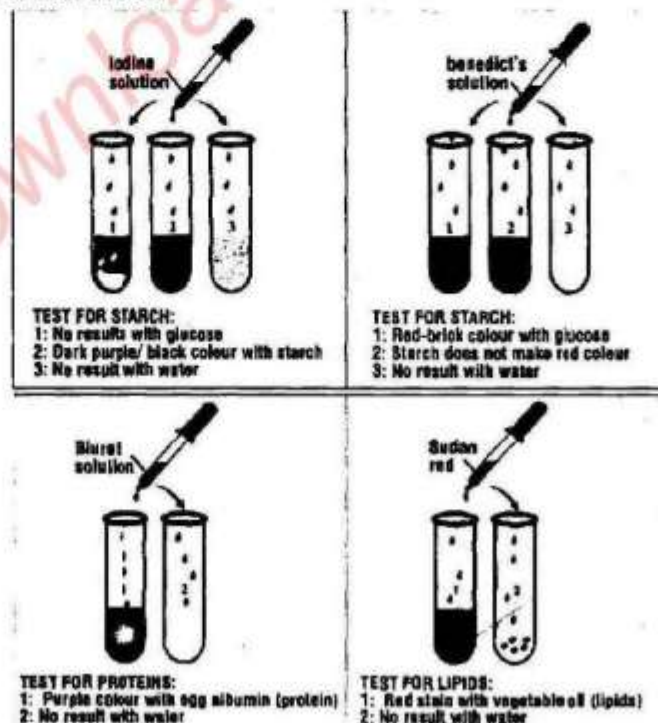
Lipids are organic compounds that can supply as much as double the amount of energy (توانائی) as carbohydrates or proteins. Testing for lipids can be done through Sudan red test. Sudan red is a fat-soluble (چربی میں حل پذیر) dye that stains lipids red. By using Sudan red the amount and the location of lipids can be shown.

Procedure of Sudan Red Test:

1. Select two clean test tubes.
2. With a wax pencil, label the tops of test tubes 1 and 2.
3. (i) To test tube 1, add 5 drops of vegetable oil.
   (ii) To test tube 2, add 40 drops of water.
4. Add 3 drops of sudan red solution to each test tube.

Observation: Sudan red will stain the lipid molecules in test tube '1'.

Result: Change in colour indicates the presence of lipids.

⇒ Record your observation regarding the colour changes in the experimental (تجرباتی) and the control test tubes.

Biochemical tests for starch, glucose, proteins and lipids

Evaluation:

(i) ***What color changes did you observe in the presence of glucose, starch, protein, and lipids.***

Ans: In case of:

(i) glucose, color changes to Red-brick color.
(ii) starch, color changes to dark purple (گہرا ارغوانی) /black color.
(iii) protein, color changes to purple color.
(iv) lipids, color changes to red stain.

(ii) ***Which test tubes contain standards that you could use for comparing tests on unknown (نامعلوم) substances?***

Ans: Test tube containing water was used as standard for comparing tests on unknown substances.

(iii) ***What are the controls in this lab?***

Ans: Ask your teacher.

(iv) ***You are asked to analyze and compare a food substance with standards for organic compounds (نامیاتی مرکبات). You observe a positive response with iodine solution and Biuret solution. What can you conclude about this food?***

Ans: Conclusion: That food substances contain starch and protein.

Q.12. Why are water and dietary fibers (ریشے) considered important in our diets (خوراک)?

Ans: ***Water and dietary fibers:***

Water and dietary fibres are not considered as nutrients, but they do play important role in life.

Water:

Water is an important part of protoplasm. Approximately (تقریباً) 60% of the adult human body is composed of water.

Importance of water:

Water has following importance in our daily life.

(i) All of the life sustaining chemical reactions require an aqueous (watery) environment.
(ii) It provides the environment in which water-soluble foodstuff is absorbed in the intestines and the waste products are eliminated in urine.
(iii) It maintains (قائم رکھتا ہے) body temperature through evaporation (عمل تبخیر), as in sweating (پسینہ آنا).
(iv) It helps enzyme to perform its function.

Problem with the deficiency of water:

Water deficiency leads to severe dehydration which may result in cardiovascular problems.

(v) It helps in digestion of food.

Required amount of water:

Estimated water requirement (ضرورت) of an adult is two litres per day.

Sources of water:

Important sources of daily water intake are natural water, milk, juicy fruits and vegetables.

Dietary Fibre:

Diet which provides us fibre is called dietary fibre.

Dietary fibre is also known as roughage.

Definition:

Dietary fibre is a part of food that is indigestible (ناقابلِ ہضم) by human.

Sources:

It is found only in plant foods and it moves undigested through the stomach and small intestine and into the colon.

Types of dietary fibres:

Dietary fibres are of two types.

(i) Insoluble dietary fibres (ii) Soluble dietary fibres

(i) Insoluble dietary fibres:

Insoluble dietary fibres travel through the small intestines (چھوٹی آنت) quickly.

Sources: Sources of insoluble fibre are:

Wheat bran, cereals and skins of many fruits and vegetables.

(ii) Soluble dietary fibres:

Soluble dietary fibre breaks down as it passes through the alimentary canal.

Sources: Oats (دلیہ), beans, barley and many fruits and vegetables are their sources.

Role of dietary fibres in our food:

Dietary fibres play important role in our life.

(i) Fibre prevents and relieves constipation (قبض) by stimulating the contraction of intestinal muscles, avoiding constipation reduces (کم کرتی ہے) the risk of many other diseases.

(ii) Soluble fibre helps in lowering blood cholesterol.
Insoluble fibre speeds up the movements of carcinogens (cancer causing agents) from intestine.

(iii) Fibre supplements should be used only with a physician's recommendations. By taking these supplements properly may help in constipation and in lowering cholesterol levels.

Q.13. Define balanced diet (متوازن غذا). How would you relate it with age, gender (جنس) and activity?

Ans: Balanced diet:

Introduction:

All humans require various types of nutrients in order to keep them healthy and fit.

These nutrients should be taken appropriately in diet.

Diet: Food on which an individual lives is called as diet.

Balanced diet:

Definition: Diet which contains all the essential (ضروری) nutrients in the correct proportion (نسبت) for the normal growth and development of the body.

Explanation:

A balanced diet is related to one's age, gender and activity. It should include different types of nutrients and should be according to the energy requirements.

Chart of common foods and the percentage of nutriens:

Following chart shows some of the common foods, taken in Pakistan, and the percentage of carbohydrates, lipids and proteins in each of them.

Food	*Carbohydrate*	*Lipid*	*Protein*
Bread (Roti)	52%	03%	09%
Rice	23%	0.1%	2.2%
Potato	19%	0.1%	02%
Apple	12.8%	0.5%	0.3%
Eggs	0.7%	12%	13%
Milk	04%	04%	03%
Butter	0.4%	81%	0.6%
Chicken	0	11%	20%

Relation of balanced diet with age, gender and activity:

Balanced diet is related to one's age, sex and activity.

Effect of age:

During growth period of the body, there is higher metabolic rate in body cells and so the body needs a balanced diet that contains more energy.

(i) Adults need less proteins per kg body weights, but a growing boy or girl needs more proteins per kg weight.

(ii) Similarly children need more calcium and iron for their growing bones and red blood cells respectively.

Effect of gender:

Gender has an impact (اثر) on the requirements of a balanced diet. Women have comparatively less metabolic rate than the men of the same age and weight. So men need a balanced diet that provides comparatively more energy.

Effect of activities:

Different people have different lifestyles (رہنے کے طریقے) and varied nature of work. A man with sedentary (بیٹھ کر کام کرنے والے) habits does not require as much energy as the man who is on his feet for most of the day.

Estimated energy requirements in (kilocalories)

		Activity Level		
Gender	**Age (years)**	**Sedentary**	**Moderately active**	**Active**
Child Male/Female	2-3	1,000	1,000-1,400	1,000-1,4000
Female	4-8	1,200	1,400-1,600	1,400-1,800
	9-13	1,600	1,600-2,000	1,800-2,200
	14-18	1,800	2,000	2,400
	19-30	2,000	2,000-2,200	2,400
	31-50	1,800	2,000	2,200
	50+	1,600	1,800	2,000-2,200
Male	4-8	1,400	1,400-1,600	1,600-2,000
	9-13	1,800	1,800-2,200	2,000-2,600
	14-18	2,200	2,400-2,800	2,800-3,200
	19-30	2,400	2,600-2,800	3,000
	31-50	2,200	2,400-2,600	2,800-3,000
	50+	2,000	2,200-2,400	2,400-2,800

Q.14. Describe how protein energy malnutrition (ناقص غذائیت), mineral deficiency diseases and over intake of nutrients are the major forms of malnutrition?

Ans: Malnutrition:

Problems related to nutrition are grouped as malnutrition.

Malnutrition is a term for the condition caused by an improper or insufficient diet.

Explanation:

Term malnutrition refers to under nutrition resulting from inadequate (ناکافی) consumption, poor absorption, or excessive loss of nutrients. Malnutrition also includes over nutrition, resulting from overeating or excessive (بہت زیادہ) intake of specific nutrients.

Most commonly, malnourished people either do not have enough calories in their diet, or are eating a diet that lacks protein, vitamins, or trace minerals.

> According to the United Nations Children's Fund (UNICEF), malnutrition contributes to the deaths of more than 6 million (ساٹھ لاکھ) children (under age five) each year.

Adverse (نقصان دہ) effects of Malnutrition:

Malnutrition weakens the immune system, impairs physical and mental health, slows thinking, stunts growth and affects fetal development.

Common forms of Malnutrition:

Common forms of malnutrition include,

(i) Protein-energy malnutrition (PEM)
(ii) Mineral deficiency disease (MDD)
(iii) Over-intake of nutrients (OIN)

(i) Protein-energy malnutrition:

Protein-energy malnutrition refers to inadequate availability (دستیابی) or absorption of energy and proteins in the body. It is the leading cause of death in children in developing (ترقی پذیر) countries.

Diseases caused by PEM:

PEM may lead to diseases such as

(i) Kwashiorkor (ii) Marasmus

(i) Kwashiorkor:

In this disease children may grow to normal height but are abnormally thin.

Cause of Kwashiorkor:

Kwashiorkor is caused due to protein deficiency at the age of about 12 months when breastfeeding (ماں کا دودھ) is discontinued, but it can also develop at any time during a child's growing age.

(ii) Marasmus:

In this disease patients lose all their body fat and muscle strength, and acquire a skeletal appearance (شکل). Children with marasmus show poor growth and look small for their age.

This disease usually develops between the ages of six months and one year.

(ii) Mineral Deficiency Diseases:

Diseases resulting from the deficiency of a mineral are relatively rare (بہت کم) among humans.

Some examples are given below.

1. Goiter:

Cause: Goiter is caused by an insufficient amount of iodine in the diet.

Function of Iodine:

Iodine is used by the thyroid gland to produce hormones that control the body's normal functioning and growth.

Symptoms:

If sufficient iodine is not available in a person's diet, thyroid gland becomes enlarged and it results in swelling (سوجن) in the neck and the condition is known as goiter.

2. Anemia:

Anemia is the most common of all mineral deficiency diseases. The term anemia literally (لفظی مطلب) means 'a lack of blood."

Cause: The condition is caused by the deficiency of iron when the number of red blood cells is reduced than the normal. Haemoglobin molecule contains a single atom of iron at its center. If body fails to receive sufficient (کافی) amounts of iron, an adequate number of haemoglobin molecules are not formed. In this case, there are not enough functioning red blood cells.

Symptoms:

Person suffering from anemia becomes weak and there is shortage (کمی) of oxygen supply to body's cells.

(iii) Over-intake of Nutrients:

Over-intake (زیادہ) of nutrients (OIN) is a form of malnutrition in which more nutrients are taken than the amounts required for normal growth, development, and metabolism. The effects of over-intake of nutrients are usually intensified (بڑھ جاتے ہیں) when there is reduction in daily physical activity.

Problems caused by over-intake:

Over-intake of nutrients causes a number of health problems.

Excess intake of carbohydrates and fats:

High intake of carbohydrates and fats leads to obesity (موٹاپا), diabetes (ذیابیطس) and cardiovascular problems.

Excess intake of vitamins:

Excess intake of vitamins also cause so many problems.

(i) High dose of vitamin A causes loss of appetite (بھوک) and liver problems.

(ii) Excess intake of vitamin D can lead to deposition of calcium in various tissues.

Q.15. What are the effects of malnutrition?

Ans: Effects of malnutrition:

The World Health Organization (WHO) estimates that, within the next few years, diseases due to malnutrition will become the principal global causes of mortality (اموات).

Hence an extended period of malnutrition can lead to following problems.

a. Starvation (فاقہ کشی) b. Heart diseases c. Constipation d. Obesity

a. Starvation:

Starvation is a severe reduction in nutrient and energy intake and is the most horrible (ہولناک) effect of malnutrition.

Effects:

In humans, prolonged starvation causes permanent organ damage and eventually results in death.

b. Heart diseases:

Heart diseases are also increasing on the global level. One of the causes of these is malnutrition. People who take unbalanced (غیر متوازن) diet (high in fats) are more exposed to heart problems.

c. Constipation:

Malnutrition often leads to situations where people cannot schedule their meals. This irregularity (بے قاعدگی) results in a number of health problems including constipation.

d. Obesity:

Obesity means becoming over-weight and it may also be due to malnutrition. People who take food that contains energy more than their requirement and do very little physical work (جسمانی کام) can become obese.

Effects:

Obesity is known as the mother-disease (بیماریوں کی ماں) and may lead to heart problems, hypertension, diabetes etc.

Q.16. What do you understand with the term Famine? Write some famines of the world? Write a note on major causes of famine.

Ans: Famine (قحط):

Definition:

Lack of enough food to feed all people living in an area is known as famine.

Terrible famines of world:

The most terrible famines of twentieth century are:

Famine of Ethiopia (1983-85)

Famine of North Korea (1990s)

Causes of famine:

The major causes of famine are unequal (غیر مساوی) distribution of food, drought (خشک سالی), flooding or increasing population.

These are discussed as

1. Unequal distribution of food:

The achievements in science have enabled human beings to produce better food in terms of quality and quantity. Today the agricultural practices produce more than enough food that can be supplied to every one on the Earth. But due to political (سیاسی) and administrative problems, the food is not equally distributed to the different regions of the world.

Effect:

The result is that there is always surplus (زائد) food in countries like America, UK, and Canada etc. and at the same time people have nothing to eat in countries like Ethiopia, Somalia etc.

2. Drought:

A drought is a period of time when there is not enough water to support agricultural and human needs.

Reason of drought:

Drought is usually due to a long period of below-normal rainfall (بارش).

Effect: Droughts decrease or even stop the crop yields resulting in famine.

3. Flooding:

Reason:

It occurs due to more than normal rainfall or due to weak water distribution system.

Due to heavy rainfall, rivers and canals overflow (چھلک پڑنا) their banks and destroy the soil quality of agricultural lands.

Effects of flooding:

It becomes impossible to grow crops immediately after (فوری بعد) flooding. In this way, flooding may be a reason for short-term famine.

4. Increasing population:

In the over-populated regions of the world, large populations overuse (بہت زیادہ استعمال) natural resources to grow maximum food in order to meet the problems of food shortage. It leads to dry and infertile lands and depletion (ختم کرنا) of resources. In such situations crops can no longer be grown and famines result.

8.3 Digestion in human

Q.17. Write a note on digestion in human.

Ans: Definition:

Process in which large and non-diffusible (غیر نفوذ پذیر) molecules (i.e proteins, polysaccharides (نشاستہ دار) and lipids) are converted into smaller and diffusible molecules that can cross the membrane is called digestion.

After digestion, the diffusible molecules from the digestive system reach body cells through blood.

⇒ In the blood diffusible molecules are assimilated (جذب کرنا).

⇒ At the same time, the indigestible part of food is eliminated out of body through process of defection.

Phases of nutrition in humans:

The nutrition in humans comprises of the following phases.

1. ***Ingestion:***

   The process of taking in food.

2. ***Digestion:***

   The process of breaking up complex (پیچیدہ) substances into simpler substances.

3. ***Absorption:***

   Diffusion of digested food into blood and lymph.

4. ***Assimilation:***

   Conversion (تبدیلی) or incorporation of absorbed simple food into the complex substances constituting the body.

5. ***Defecation (خارج کرنا):***

   Elimination of undigested (غیر ہضم شدہ) food from the body.

Q.18. Describe the structures and functions of the main regions of the alimentary canal.

Ans. Alimentary Canal (غذائی نالی):

Definition: Digestive system consists of a long tube that extends from the mouth to the anus (مقعد). This tube is called alimentary canal.

Sections of alimentary canal:

Main sections of alimentary canal are as follows.

1. Oral cavity 2. Pharynx 3. Oesophagus
4. Stomach 5. Small intestine 6. Large intestine

Glands of alimentary canal:

Important glands of alimentary canal are:

1. Three pairs of salivary glands 2. Pancreas (لبلبہ) 3. Liver

Structure and function of alimentary canal:

Lets see when a bite of bread is taken with some dish (like mutton) how it is converted into small molecules like amino acids, simple sugars, fatty acids, vitamins, salts and water.

1. Oral cavity:

Oral cavity is the space behind mouth and has many important functions in the whole process of digestion.

Selection of food:

Selection of food is very important function of oral cavity. When food enters oral cavity, it is tasted and felt. If the taste of mutton suggests that it is old, we reject (رد کر دیتے ہیں) it. If the teeth or tongue detect some hard object, such as dirt, we also reject that bite. The senses (حسیں) of smell and vision also help oral cavity in the selection of food.

Grinding of food:

Grinding of food is also known as chewing or mastication (چبانا). Chewing of food is important by two reasons.

First: Oesophagus can pass only small pieces.

Second: Enzymes cannot act on large pieces of food. They require small pieces with large surface areas to attack.

Lubrication and chemical digestion of food:

The third and fourth functions of oral cavity are lubrication and chemical digestion of food.

Chewing process stimulates (تحریک پیدا کرتا ہے) the three pairs of salivary glands.

Location of salivary glands:

The salivary glands are present in following locations.

(i) Under the tongue (ii) Behind the jaws (جبڑے) (iii) Infront of ears

All of three salivary glands release a juice called saliva in oral cavity.

Functions of saliva:

Saliva has two main functions.

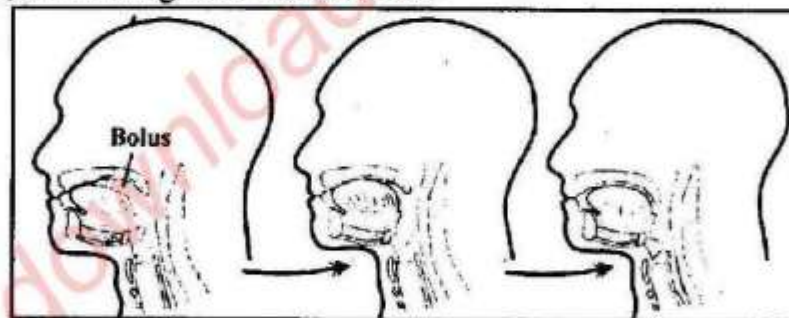
(i) It adds water and mucous (لیسدار مادہ) to the food which act as lubricant (چکنا کرنے والا) to ease the passage of food through oesophagus.

(ii) Saliva contains an enzyme salivary amylase, which helps in the semi-digestion of starch.

After all above processes this partial (جزوی) digested pieces of bread and mutton are rolled up by the tongue into small, slippery, spherical mass called bolus. Bolus is swallowed (نگلا جاتا ہے) and pushed in oesophagus through the pharynx.

2. Pharynx and oesophagus (Swallowing and Peristalsis):

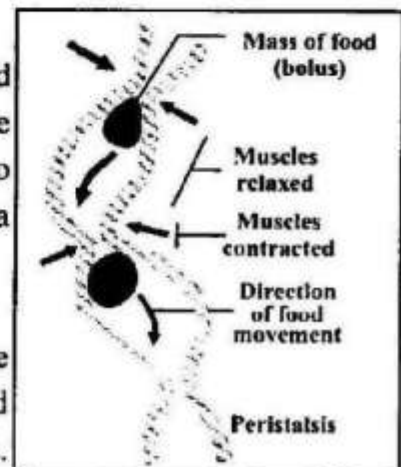
During swallowing, bolus is pushed to the back of the mouth by the tongue. When tongue pushes bolus, the soft palate also moves upward and to rear (پیچھے). In this way, opening of nasal cavity is closed. When swallowed, the bolus goes the pharynx to enter oesophagus. Pharynx has adaptations (ڈھل جانے کی خاصیت) to prevent the entry of bolus particles in trachea.

During swallowing, larynx (top of trachea) moves upward, and forces the epiglottis (a flap of cartilage) into horizontal (افقی) position Thus glottis i.e. opening of and trachea is closed. The beginning of the swallowing action is voluntary, but once food reaches the back of mouth, swallowing becomes automatic.

Steps in swallowing

Oesophagus:

After being swallowed, the food enters the tube called the oesophagus, which connects the pharynx to the stomach. Neither pharynx nor oesophagus contributes to digestion and the previous (پہلا) digestive actions of saliva continue.

Peristalsis:

Peristalsis moves the food from oral cavity to the rectum. It is defined as waves of contraction (سکڑنا) and relaxation in the smooth muscles of alimentary canal walls.

4. Stomach:

Shape and location: The stomach is a dilated (پھیلا ہوا) part of the alimentary canal. It is J-shaped, located in the left of the abdomen, just beneath (بالکل نیچے) the diaphragm.

Parts of stomach: Stomach has two main parts.

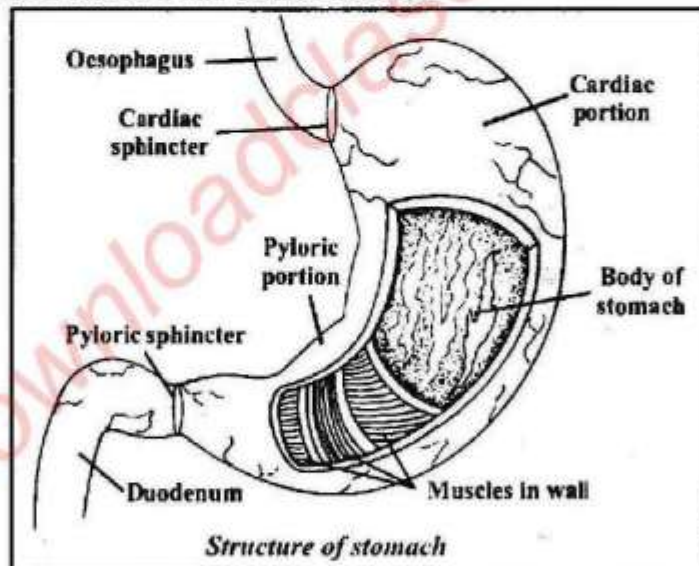
(i) Cardiac part:
This part is present immediately after oesophagus.

(ii) Pyloric part:
This part is located (واقع ہے) beneath the cardiac portion.

Sphincters of Stomach:
Stomach has two openings which are guarded by muscles. These openings are called sphincters.

(i) Cardiac sphincter:
Cardiac sphincter is between stomach and oesophagus.

(ii) Pyloric sphincter:
This is between stomach and small intestine.

Structure of stomach

The bolus enters the stomach from oesophagus through the cardiac sphincter.

Function of stomach:
When food enters stomach, the gastric glands found in the wall are stimulated to secrete (خارج کرتے ہیں) gastric juice.

Composition of gastric juice:
It is composed of mucous, hydrochloric acid, and pepsinogen (a protein digesting enzyme).

Function of HCl:

(i) Hydrochloric acid converts the inactive (غیر متحرک) enzyme pepsinogen into its active form called pepsin.

(ii) HCl kills microorganisms present in food.

Function of pepsin:

Pepsin partially digests the protein of the food into polypeptides and shorter peptide chains.

Process of churning in stomach:

In the stomach, food is further broken apart through a process of churning (بلونا).

(i) The walls of the stomach contract and relax and these movements help in thorough mixing of the gastric juice and food.

(ii) The churning action also produces heat which helps to melt (پگھلانا) lipid (نامیاتی مرکبات) content of the food.

Formation of chyme:

The starch in our bite of bread and the protein in mutton have been partially digested and the food has been converted to a soup-like mixture called chyme (نیم ہضم شدہ صورت). After it, the pyloric sphincter allows a little mass of chyme to enter duodenum.

5. Small Intestine-Complete digestion and absorption:

Small intestine is further divided into following parts.

(i) Duodenum:

Duodenum is the first part of small intestine. It is comprised of the first 10 inches (25cm) of the small intestine.

It is the part of alimentary canal where most of the digestive process occurs.

Here, food is further mixed with 3 different secretions.

a. Bile:

It is secretion of liver and helps in digestion of lipid through emulsification (نامیاتی مرکب بنانا).

b. Pancreatic juice:

Pancreatic juice is a secretion of pancreas. It contains enzymes trypsin, pancreatic amylase and lipase which digest proteins, carbohydrates and lipids respectively.

c. Intestinal juice:

Intestinal juice is secreted from the walls of intestine. It contains many enzymes for the complete digestion of all kinds of food.

(ii) Jejunum:

Next part of duodenum is 2.4 meters long and is called jejunum.

Function:

Jejunum is concerned with the rest (باقی ماندہ) of digestion of proteins, carbohydrates and lipids of our bite.

(iii) Ileum:

Last part of small intestine is ileum. It is 3.5 meters long.

Function: Ileum is concerned with the absorption (جذب کرنا) of digested food.

Structure of Ileum:

Villi: There are circular (گول) folds in the inner wall of ileum. These folds have numerous (بہت سے) finger-like projections called villi.

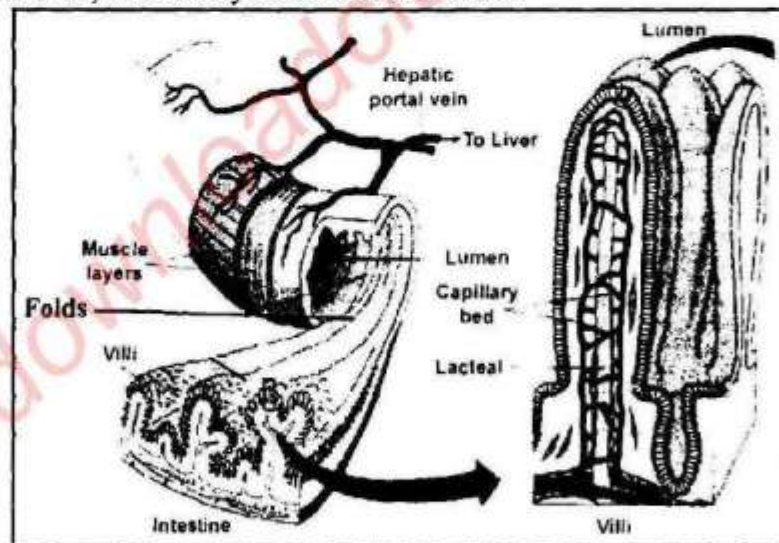
Function of villi:

Villi increases the surface area of inner walls (اندرونی دیواریں) and it helps a lot in the absorption of digested food.

Capillaries and lacteal:

Each villus is richly supplied with blood capillaries and a vessel of lymphatic system, called lacteal.

Absorption of food:

The walls of the villus are only one cell thick (موٹی). The digested molecules i.e. simple sugars, and amino acids are absorbed from the intestine into the blood capillaries present in villi. The blood carries them away from the small intestine via hepatic portal vein and goes to the liver for filtering. Here toxins are removed and extra food is stored from liver, the required food molecules go towards heart via the hepatic vein. Fatty acids (چربیلے تیزاب) and glycerol are absorbed into the (lacteal) of villus, which carries them to the main lymphatic duct, where they enter in bloodstream.

Folds and villi in small intestine

6. Large intestine-absorption of water and defecation:

After the digested products of our bite have been absorbed in blood, the remaining (بچا) mass enters the large intestine.

Parts of large intestine:

Large intestine has three parts.

(i) Caecum (ii) Colon (iii) Rectum

Caecum:

It forms the T-junction (T شکل کا جوڑ) with the small intestine.

Colon:

From colon, water is absorbed into blood. As the water is absorbed, the solid remains of the food are called faeces (فضلہ). The faeces contain the undigested material.

A large number of bacteria, sloughed off cells of the alimentary canal, bile pigments and water are also part of the faeces.

Rectum:

Faeces are temporarily stored in the rectum, which opens out through anus. Under normal condition when the rectum is filled up with faeces, it gives rise to a reflex and anus is opened for defecation.

This reflex is consciously inhibited in adults but in infants (نوزائیدہ بچے) it is controlled involuntarily. During growth, the child learns to bring this reflex under voluntary control.

Q.19. Write a note on gastric juice.

Ans: ***Gastric juice:***

Gastric glands of stomach secrete gastric juice. Gastric juice is secreted by following processes.

1. When we bite off a piece of rotti and mutton (بکری کا گوشت), then swallow it, there is some gastric juice already present in the stomach.
2. Sometimes sight of food causes the release (اخراج) of gastric juice.
3. When the bite is in oral cavity, brain sends messages to stomach wall to secrete some gastric juice.
4. When food reaches stomach, more gastric juice is secreted according to needs.

If little amount of protein is present in bite, the stomach does not secrete more gastric juice. On the other hand if more proteins are present in food, abundant (کافی) gastric juice is secreted.

Action of gastric juice:

When gastric juice is mixed with food, the huge protein molecules are broken down into peptides. These peptides stimulate some cells of the stomach walls to release a hormone called gastrin.

When gastrin enters blood and is distributed (تقسیم ہو جاتی ہے) to all parts of the body, including stomach here it has specific effect (خاص اثر) and stimulates the cells of gastric glands to secrete more gastric juice.

Q.20. What is liver? What do you know about its structure? Write importance of liver in digestion.

Ans. Liver (جگر):

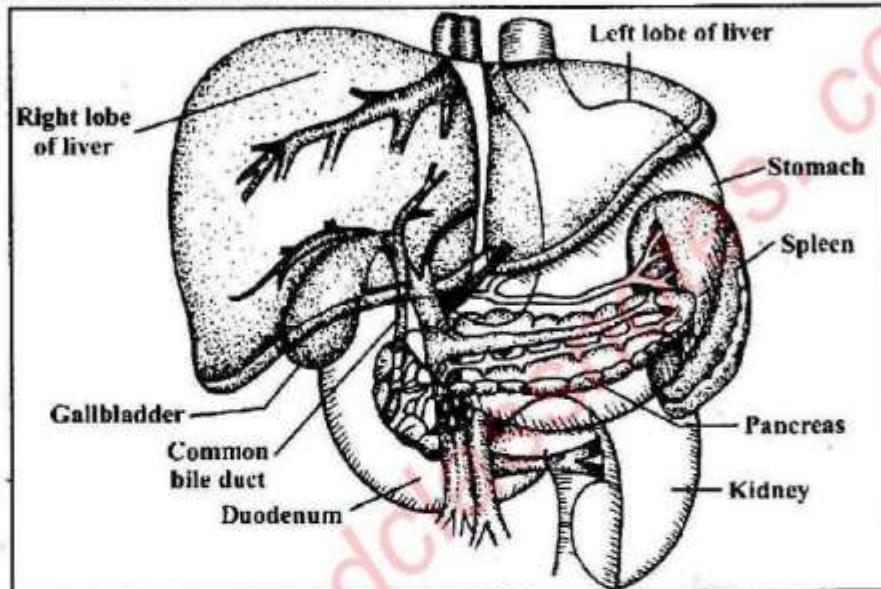
It is a dark reddish (گہرا سرخ) internal organ of body. It is the largest gland of the body.

Size: In an adult human it weighs about 1.5kg and is the size of a foot ball.

Location:

Liver lies (واقع ہے) beneath the diaphragm on the right side of the abdomen.

Gallbladder:

A pear-shaped (ناشپاتی کی شکل کا) greenish yellow (سبزی مائل پیلا) sac, the gallbladder lies along the right lobe of liver on the ventral side.

Liver and associated organs

Secretion of liver:

Liver secretes bile; which is stored in the gallbladder. When the gallbladder contracts, bile is released into the duodenum through the **common bile duct**.

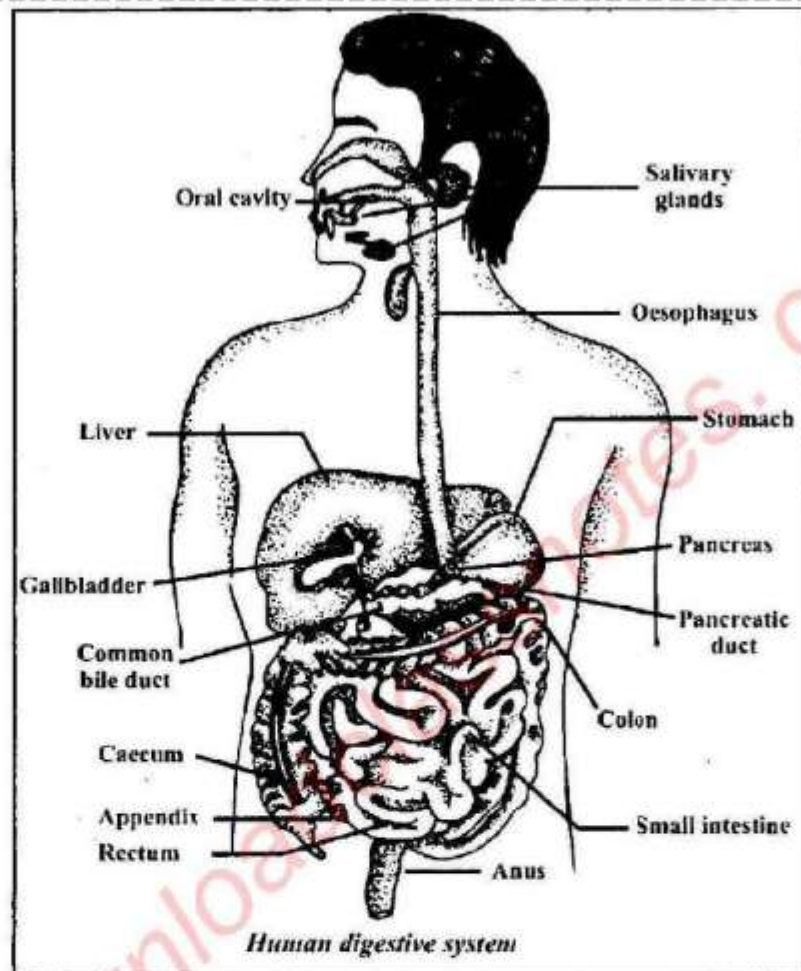
Function of Bile:

Bile has no enzymes but contains bile salts for the emulsification of lipids.

Other functions of liver:

Besides digestion, liver carries out a number of other functions. Some of which are summarized here.

1. Removes amino groups from amino acids **(de-amination)**
2. Converts (بدلتا ہے) ammonia to a less toxic (کم مہلک) form i.e. **urea.**
3. Destroys the old red blood cells.
4. Manufactures blood clotting proteins called fibrinogen.
5. Converts glucose into glycogen and, when required, breaks glycogen into glucose.
6. Converts carbohydrates and proteins into fats, and produce cholesterol.
7. Produces heat to maintain body temperature (جسمانی درجہ حرارت).
8. Stores fat-soluble vitamins (A,D,E, and K) and mineral (معدنی) ions, such as iron.

Human digestive system

8.4 Disorders of Gut

Q.21. Briefly give the signs and symptoms, causes, treatments and preventions of diarrhoea, constipation (قبض) and ulcer.

Ans. ***Diarrhoea:***

Diarrhoea is a common disorder of gut. It is a condition in which the sufferer has frequent watery, loose bowel movements.

Symptoms:

In diarrhoea sufferer has abdominal pain (پیٹ درد), nausea, and vomiting.

Causes:

(i) Diarrhoea occurs when required water is not absorbed in blood from the colon.

(ii) If sufficient food and water is available, a patient recovers from diarrhoea in a few days. However for malnourished individuals diarrhoea can lead to severe dehydration (پانی کی کمی) and can become life-threatening.

(iii) The main causes of diarrhoea include lack of adequate (کافی) safe water. It is also

caused by viral or bacterial infections of large intestine.

Treatment:

1. Adequate amount of water, preferably mixed with essential (ضروری) salts and nutrients should be consumed by patient to replace loss.
2. In case of bacterial infections antibiotics may be required by patient.

Prevention:

Diarrhoea may be prevented by taking clean water and essential salts, eating regularly and taking hygienic measures.

Constipation:

Symptoms: In constipation, a person experiences hard faeces that are difficult to eliminate.

Causes:
1. Excessive (بہت زیادہ) absorption of water through colon.
2. Insufficient (ناکافی) intake of dietary fibre.
3. Dehydration.
4. Use of medicines containing iron, calcium and aluminium.
5. Tumours (رسولیاں) in the rectum or anus.

Treatment:
1. Change in dietary and exercise habits.
2. Laxatives (e.g. paraffin) are used for treatment.

Prevention:

Proper intake of required quantity of water and dietary fibres would prevent a person from constipation.

Ulcer: Ulcer is a sore in the inner wall of the gut.

In ulcer, the acidic gastric juice gradually breaks down the tissue of the inner wall.

Types of Ulcer:

1. **Gastric ulcer:** Ulcer of stomach is called gastric ulcer.
2. **Duodenal ulcer:** Ulcer of duodenum is called duodenal ulcer.
3. **Oesophagus ulcer:** Ulcer of oesophagus is called oesophageal ulcer.

Causes: Causes of ulcer are:

1. Excess acid
2. Infection
3. Long term use of anti-inflammatory medicines (e.g. aspirin)
4. Smoking (سگریٹ نوشی)
5. Drinking coffee
6. Drinking colas
7. Eating spicy food

Symptoms:

Symptoms (علامات) of ulcer are:

1. Abdominal burning after meals or at midnight.

2. Abdominal pain.
3. Rush of saliva after an episode of regurgitation.
4. Nausea.
5. Loss of appetite and weight loss.

Prevention:

Spicy food and those containing more acidity should be prevented. As smoking is a major factor of ulcer so it should be avoided.

Treatment:

Ulcer is treated with medicines, which neutralize the acid effects (تیزابی اثرات) of gastric juice.

Review Questions

MULTIPLE CHOICE

1. **What are the primary nutrients that provide quick useable energy to body?**
   (a) Carbohydrates (b) Proteins (c) Lipids (d) Nucleic acids
2. **The wavelike movement of muscle that pushes food through digestive system is called;**
   (a) Churning (b) Emulsification (c) Absorption (d) Peristalsis
3. **Micronutrients of plants are;**
   (a) Available in the soil only in small amounts
   (b) Required by plants in small amounts
   (c) Small molecules required by plants
   (d) Useful, but not required by plants
4. **Which of the following does not occur in oral cavity?**
   (a) Lubrication of food
   (b) Beginning of protein digestion
   (c) Breaking the food into small fragments
   (d) All of the above do occur in oral cavity
5. **Where are the villi found?**
   (a) Esophagus (b) Stomach (c) Small intestine (d) Large intestine
6. **Ulcers occur in;**
   (a) Stomach (b) Duodenum (c) Esophagus (d) All of these
7. **Which group of enzymes breaks up starches and other carbohydrates?**
   (a) Proteases (b) Lipases (c) Amylases (d) None of these
8. **Pancreas produces digestive enzymes and releases them into;**
   (a) Colon (b) Gallbladder (c) Liver (d) Duodenum

9. In stomach, pepsinogen is converted into;
(a) Pepsin (b) Bicarbonate (c) HCl (d) Gastrin

10. Hepatic portal vein carries blood from _______ to _______.
(a) Small intestines, liver (b) Small intestines, heart
(c) Liver, heart (d) Small intestines, colon

11. Which of the following is not a function of liver?
(a) Converts glucose to glycogen (b) Converts glycogen to glucose
(c) Manufactures fibrinogen (d) Produces digestives enzymes

12. The diseases of Kwashiorkor and marasmus may be due to;
(a) Mineral deficiency (b) Over-intake of nutrients
(c) Protein-energy malnutrition (d) Ulcer

13. Which food group in our body is best source of energy?
(a) Meat Group (b) Fats, oils and sweets
(c) Breads and cereals (d) Milk and cheese

14. What may be the reason that children need more calcium and iron?
(a) Both calcium and iron for bones
(b) Both calcium and iron for blood
(c) Calcium for blood and iron for bones
(d) Calcium for bones and iron for blood

15. The process of breaking down large droplets of fat into small droplets is called:
(a) Emulsification (b) Absorption (c) Peristalsis (d) Digestion

Ans: **1.** Carbohydrates **2.** Peristalsis **3.** Required by plants in small amounts
4. Beginning of protein digestion **5.** Small intestine **6.** All of these
7. Amylases **8.** Duodenum **9.** Pepsin **10.** Small intestines, liver
11. Produces digestives enzymes **12.** Protein-energy malnutrition
13. Breads and cereals **14.** Calcium for bones and iron for blood
15. Emulsification

UNDERSTANDING THE CONCEPTS

1. What are the effects of the lack of nitrate and magnesium ions on plant growth?

Ans: Refer to Q.No.3 for answer.

2. How are inorganic and organic fertilizers important in agriculture?

Ans: Refer to Q.No.4 for answer.

3. Draw a table that can show sources, energy values and functions of carbohydrates, proteins and fats.

Ans: Refer to Q.No.6 for answer.

4. ***How are vitamins A, C and D important in our diets?***

Ans: Refer to Q.No.10 for answer.

5. ***Which foods contain calcium and iron and what role these minerals play in our bodies?***

Ans: Refer to Q.No.9 for answer.

6. ***Why are water and dietary fibres considered important in our diets?***

Ans: Refer to Q.No.12 for answer.

7. ***Define balanced diet. How would you relate it with age, gender and activity?***

Ans: Refer to Q.No.13 for answer.

8. ***Describe how protein energy malnutrition, mineral deficiency diseases and over intake of nutrients are the major forms of malnutrition?***

Ans: Refer to Q.No.14 for answer.

9. ***How would you advocate the unequal distribution of food as the major factor that contributes to famine?***

Ans: Refer to Q.No.16 for answer.

10. ***Describe structures and functions of the main regions of alimentary canal.***

Ans: Refer to Q.No.18 for answer.

11. ***Describe swallowing and peristalsis.***

Ans: Refer to Q.No.18 for answer topic # 2 (Pharynx and oesophagus)

12. ***Briefly give the signs and symptoms, causes, treatments and preventions of diarrhoea, constipation, and ulcer.***

Ans: Refer to Q.No.21 for answer.

SHORT QUESTIONS

1. ***What are the health risks if we take more saturated fatty acids in our diet?***

Ans: Saturated fatty acids can increase a person's cholesterol level. An increased cholesterol level may eventually result in the clogging of arteries and, ultimately, heart disease.

2. ***How can the deficiency of vitamin A cause blindness?***

Ans: Vitamin A combines with a protein called opsin to form rhodopsin makes it difficult to see in dim light.

3. *How will you differentiate between bolus and chyme?*

Ans: ***Bolus:*** During the processes of chewing, lubrication and semi-digestion, the pieces of food are rolled up by the tongue into small, slippery, spherical mass called bolus.

Chyme: The starch in our bite of bread and the protein in mutton have been partially digested and the food has been converted to a soup-like mixture called chyme.

4. *Which sphincters play role in the movement of food in and out of stomach?*

Ans: Cardiac sphincter plays role in the movement of food in the stomach.
Pyloric sphincter plays role in the movement of food out of the stomach.

5. *Stomach is an organ of the digestive system, but it also secretes a hormone. What hormone is it and what function it performs?*

Ans: Stomach walls release a hormone called gastrin. This hormone enters blood and is distributed to all parts of body. In stomach, it has specific effect and stimulates the gastric glands to secrete more gastric juice.

ACTIVITIES

1. Perform tests for starch, reducing sugars, proteins and fats.

THE TERMS TO KNOW

Amylase:

It is an enzyme which helps in the partial digestion of starch.

Anemia:

Term anemia literally means 'a lack of blood'. In other words it is a disease in which number of red blood cells is reduced to a level lower than the normal.

Appendix:

From the blind end of caecum there arises a non-functional finger-like projection called appendix.

Assimilation:

Conversion or incorporation of absorbed simple food into the complex substances constituting the body.

Balanced diet:

A diet which contains all the essential nutrients like carbohydrate, fats, protons, minerals vitamins in the correct proportion for the normal growth and development of the body.

Bolus:

Partially digested food rolled up by the tongue into small, slippery, spherical mass

called bolus.

Cardiac sphincter:

It is the opening between stomach and oesophagus.

Chyme:

Partially digested soup like mixture which enters from stomach to duodenum is called chyme.

Colon:

Middle portion of large intestine, from where water is absorbed into blood is called colon.

Constipation:

It is a condition in which a person experiences hard faeces that are difficult to eliminate.

Diarrhoea:

It is a condition in which the sufferer has frequent watery, loose bowel movements.

Dietary fibre:

Dietary fibre also known as roughage. It is the part of human food that is indigestible.

Digestion:

Process in which large and non-diffusible molecules (i.e Proteins, Polysaccharides and lipids) are converted into smaller and diffusible molecules (i.e salts, animo acids, simple sugars, fatty acids and vitamins) is called digestion.

Duodenum:

Duodenum is the first part of small intestine. It comprises of the first 10 inches (25cm) of the small intestine. Most of the digestive process occurs here.

Emulsification:

The process of breaking down large droplets of fat into small droplet, of fat is called emulsification.

Epiglottis:

A flap of cartilage which is responsible for opening or closing of the glottis is called epiglottis.

Famine:

Lack of enough food to feed all the people living in an area is known as famine.

Fat-soluble vitamins:

Vitamins which are insoluble in water and soluble in fats are called fat-soluble vitamins.

Examples: Vitamin A,D,E and K are fat soluble vitamins.

Fertilizer:

Materials which are added to soil resulted in plants with desirable characteristics

(e.g more fruit, faster growth, better color, more attractive flowers) are called fertilizers.

Gastric juice:

Secretion of stomach which is composed of mucous, hydrochloric acid and a protein digesting enzyme is called gastric juice.

Gastrin:

A hormone which enters in blood and then to all part of body including stomach. It affects cells of gastric glands to secrete more gastric juice.

Goiter:

It is a condition which is caused by an insufficient of iodine in the diet.

If sufficient iodine is not available in a person's diet, the thyroid gland becomes enlarged and it results, in swelling in the neck and the condition is known as goiter.

Ileum:

Last part of small intestine is called ileum. It is 3.5 meters long.

Intestinal juice:

Intestinal juice is secretion of intestine which is secreted by the inner lining of intestine.

Which contains many enzymes for the complete digestion of all kinds of food.

Jejunum:

Jejunum is the second part of small intestine. It is 2.4 meters long.

Kwashiorkor:

It is a disease caused by the protein deficiency at the age of about 12 months, when breast feeding is discontinued.

In this disease children may grow to normal height but are abnormally thin.

Lacteal:

Each villus is richly supplied with blood capillaries and a vessel of lymphatic system called lacteal.

Lacteal or lymphatic vessel is present in villi in which fatty acids and glycerol are absorbed. After that lacteal carries them to the main lymphatic duct.

Laxatives:

Laxative is a medicin used for treatment of constipation.

Example: Paraffin

Lipase:

It is an enzyme which digest lipids.

Liver:

It is the largest gland of body. It is dark reddish organ.

Malnutrition:

Malnutrition is a term for the condition caused by an improper or insufficient diet.

Marasmus:

It is a disease which is caused by protein-energy malnutrition.

Children with marasmus show poor growth and look small for their age.

Mineral deficiency diseases:

Diseases caused by the deficiency of minerals are goiter and anemia. Goiter is caused by the deficiency of iodine while anemia is caused by the deficiency of iron.

Nutrition:

The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy, is called nutrition.

Oesophagus:

It is the tube like part of alimentary canal which connects the pharynx to the stomach.

Oral cavity:

It is the first part of alimentary canal which is the space behind the mouth.

Over-intake of nutrients:

It is the form of malnutrition in which more nutrients are taken than the amounts required for normal growth, development and metabolism.

Pancreas:

It is a leaf shaped organ which secretes pancreatic juice. It contains three enzymes trypsin, pancreatic amylase and lipase which digest proteins, carbohydrates and lipids respectively.

Pancreatic juice:

It is the secretion of pancreas having three enzymes trypsin, pancreatic amylase and lipase. Which digest proteins, carbohydrates and lipids respectively.

Pepsin:

It is the activated form of pepsinogen.

Pepsinogen:

It is a protein digesting enzyme present in gastric juice.

Peristalsis:

The wavelike movement of muscle that pushes food through the digestive system is called perislatsis.

Pharynx:

It is the second part of alimentary canal and lies next of oral cavity.

Protein-energy malnutrition:

It refers to inadequate availability or absorption of energy and proteins in the body.

Pyloric sphincter:

It is the opening between stomach and small intestine.

Rectum:

It is the last part of alimentary canal in which faeces are temporarily stored.

Saliva:

It is the secretion of oral cavity, which is secreted during chewing process of food. Chewing process stimulates three sets of salivary glands to release saliva.

Starvation:

It is a severe reduction in nutrients and energy intake and is the most horrible effect of malnutrition.

Stomach:

It is a dilated part of the alimentary canal. It is J-shaped, located in the left of the abdomen, just beneath the diaphragm.

Swallowing:

Pushing of bolus from oesophagus to pharynx is called swallowing.

During swallowing the bolus is pushed to the back of the mouth by the tongue and bolus moves to pharynx.

Trace minerals:

Minerals which are required in very low quantities i.e. less than 100 mg per day are called trace minerals.

Examples: Nickel, Chlorine, Zinc, Boron etc.

Trypsin:

It is an enzyme of pancreatic juice secreted by pancreas which digest carbohydrates.

Ulcer:

It is a sore in the gut lining caused by a gradual breakdown of the tissue by the acidic gastric juice.

Villus:

Circular folds in the inner walls of the ileum which have numerous finger like projections called villus.

Vitamins:

These are chemical compounds that are required in low amounts but are essential for normal growth and metabolism.

Water-soluble vitamins:

These vitamins are soluble in water.

Examples: Vitamin B and Vitamin C.

INITIATING AND PLANNING

1. Investigate and present in a tabulated data from your daily food intake (in terms of nutrients and calories).
2. Identify the villus; epithelium, capillary network and lacteal while examining the transverse section of small intestine.

SCIENCE, TECHNOLOGY AND SOCIETY

1. Explain why farmers use chemical fertilizers for better growth of their plants.
2. Describe ways in which research about nutrition has brought about improvements in human health (e.g.,development of nutritional supplements, and diets based on the needs of age, gender and activity).
3. Exemplify the societies suffering from famine due to unequal distribution of food and due to over-population.
4. Explain how the customary food habits contribute to digestive tract disorders (e.g. diarrhoea, constipation).

ON-LINE LEARNING

- nutrition.about.com/od/foodpyramid/
- www.enchantedlearning.com/subjects/anatomy/digestive/
- kitses.com/animation/swfs/digestion.swf
- healthresources.caremark.com/topic/digestivesystem

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS

(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **How much % of Lipid is present in milk?** (LHR. GI, RWP. GI)
   (A) 10 % (B) 12 % (C) 0.9 % (D) 04 %
2. **Fat soluble vitamins are:** (LHR. GI)
   (A) A,B,C,D (B) A,D,E,K (C) A,C,E,K (D) B,C,E,D
3. **Proteins are composed of:** (LHR. GII)
   (A) Fatty Acids (B) Acetic Acid (C) Amino Acids (D) Minerals
4. **Elimination of undigested food from the body is called:** (LHR. GII)
   (A) Ingestion (B) Absorption (C) Digestion (D) None of these
5. **One gram of protein has ________ amount of energy.** (GRW. GI, RWP. GII, DGK. GI)
   (A) 2.4 K. cal (B) 4 K. cal (C) 5 K.cal (D) 4.6 K.cal
6. **Daily need of major minerals is ________.** (GRW. GI)
   (A) more than 100 mg (B) 100 mg
   (C) less than 100 mg (D) 10 mg

7. **Where are villi found?** (GRW. GII, LHR. GII, FBD. GI, BWP. GI & GII)
   (A) stomach (B) small intestine (C) oesophagus (D) large intestine
8. **Disease scurvy is caused by the deficiency of ________.** (GRW. GII, MLN. GII)
   (A) vitamin A (B) vitamin B (C) vitamin C (D) vitamin D
9. **Which mineral is essential for development and maintenance of bones and teeth?** (FBD. GI)
   (A) Potassium (B) Sodium (C) Iodine (D) Calcium
10. **In adult human, oesophagus length is about:** (FBD. GI & GII)
   (A) 20cm (B) 25cm (C) 30cm (D) 35cm
11. **In Stomach, Pepsinogen is converted into:** (MLN. GI, FBD. GI & GII, SGD. GI)
   (A) Pepsin (B) Bicarbonates (C) HCl (D) Gastrin
12. **The disease caused by deficiency of Protein is:** (MLN. GI)
   (A) Goiter (B) Osteoarthritis (C) Marasmus (D) Colour Blindness
13. **Element required for the function of Harmone Insuline is:** (MLN. GII)
   (A) Iron (B) Chromium (C) Zinc (D) Sodium
14. **The wave like movement of muscles that pushes food through digestive system is called.** (SWL. GI)
   (A) emulsification (B) churning (C) absorption (D) peristalsis
15. **What are the primary nutrients that provide quick useable energy to the body?** (SWL. GI)
   (A) lipids (B) carbohydrates (C) proteins (D) nucleic acids
16. **One gram of carbohydrates has kilo calori energy:** (SWL. GII, RWP. GI, LHR. GI)
   (A) 2 (B) 4 (C) 6 (D) 8
17. **Disease of rickets occurs in children due to lack of vitamin:** (SWL. GII, GRW. GII)
   (A) vitamin A (B) vitamin B (C) vitamin C (D) vitamin D
18. **The second function of oral cavity is the grinding of food by teeth is called:** (SGD. GI)
   (A) Lubrication (B) Defecation (C) Mastication (D) Assimilation
19. **Faeces are temporarily stored in:** (SGD. GI)
   (A) Appendix (B) Rectum (C)Gall bladder (D) Pancreas
20. **The process of breaking up of complex substances into simpler substances is:** (SGD. GII)
   (A) Ingestion (B) Digestion (C) Assimilation (D) Absorption
21. **Which vitamin is water soluble?** (SGD. GII)
   (A) Vitamin A (B) Vitamin B complex (C) Vitamin D (D) Vitamin E
22. **The most widely used carbohydrate to get energy is:** (RWP. GII)
   (A) Maltose (B) Sucrose (C) Glucose (D) Lactose
23. **The disease caused by the defficiency of iodine is:** (DGK. GI, GRW. GI, MLN. GII)
   (A) Scurvy (B) Rickets (C) Malaria (D) Goiter

24. The diseases of Kwachiokar and marasmus may be due to: (DGK. GII)
(A) Ulcer (B) Mineral deficiency
(C) Over intake of nutrients (D) Protein energy mal nutrition

25. The Reabsorption of water and salts is done in: (BWP. GI)
(A) Large Intestine (B) Small Intestine (C) Stomach (D) Liver

26. The example of Micronutrients is: (BWP. GI)
(A) Phosphorous (B) Calcium (C) Sulphur (D) Iron

27. The disease caused by the deficiency of Vitamin A is: (BWP. GII, SGD. GI)
(A) Scurvy (B) Rickets (C) Osteomalacia (D) Night Blindness

28. One Gram of Lipids contains energy: (BWP. GII)
(A) 4 Kilo Calories (B) 9 Kilo Calories (C) 10 Kilo Calories (D)11 Kilo Calories

29. The name of compound that converts inactive enzyme pepsinogen into pepsin is: (LHR. GI)
(A) Hydrochloric acid (B) Water (C) Mucus (D) Lipase

30. What are the primary nutrients that provide quick useable energy to body: (LHR. GII)
(A) Lipids (B) Nucleic acids (C) Proteins (D) Carbohydrates

31. Last 3.5 meter long part of the small intestine is called: (GRW. GI)
(A) jejunum (B) rectum (C) colon (D) ileum

32. The intake of food is called. (GRW. GII, BWP. GII)
(A) digestion (B) ingestion (C) digestion (D) egestion

33. Why children need more calcium and iron? (FBD. GII)
(A) For bones (B) For blood
(C) Calcium for bones and iron for blood (D) Calcium for blood and iron for bones

34. The organ specialized for the digestion of proteins and for storing food is: (MLN. GI)
(A) Liver (B) Stomach (C) Pancreas (D) Oral Cavity

35. Disease due to the deficiency of Vitamin "C" is: (MLN. GI)
(A) Scurvy (B) Rickets (C) Osteomalacia (D) Dry Skin

36. In _____ of the elementary canal, the maximum absorption of nutrients occurs. (MLN. GI, SWL. GI)
(A) Small intestine (B) Large intestine (C) Pharynx (D) Stomach

37. __________ acid is present in Pepsin: (MLN. GII)
(A) H_2SO_4 (B) H_2CO_3 (C) HNO_3 (D) HCl

38. The example of insoluble dietary fibre in human food is: (SWL. GI)
(A) beans (B) wheat brans (C) rice (D) barley

39. "Lack of blood" is called disease namely: (SWL. GII)
(A) kwarshiorkor (B) anemia (C) marasmus (D) goiter

40. Water soluble Vitamin is. (SGD. GII)
(A) A (B) D (C) B (D) E

41. Which Vitamin is made by bacteria in colon? (RWP. GI)
(A) Vitamin C (B) Vitamin D (C) Vitamin E (D) Vitamin K

42. A water soluble vitamin is: (RWP. GII)
(A) D (B) C (C) E (D) A

43. The weight of liver of an adult person is: (DGK. GII)
(A) 3 Kg (B) 1.5 Kg (C) 1.8 Kg (D) 1.2 Kg

44. Whose saying is this that make medicine to your nutrition: (DGK. GII)
(A) A.F.A King (B) Aristottle (C) Buqrat (D) Suqrat

45. Deficiency of which elements causes the yellowing of leaves in plants: (BWP. GI)
(A) Zinc (B) Chlorine (C) Copper (D) Magnesium

Answers

1. 04 % **2.** A,D,E,K **3.** Amino Acids **4.** None of these **5.** 4 K. cal
6. more than 100 mg **7.** small intestine **8.** vitamin C **9.** Calcium
10. 25cm **11.** Pepsin **12.** Marasmus **13.** Zinc **14.** peristalsis
15. carbohydrates **16.** 4 **17.** vitamin D **18.** Mastication **19.** Rectum
20. Digestion **21.** Vitamin B complex **22.** Glucose **23.** Goiter
24. Protein energy mal nutrition **25.** Large Intestine **26.** Iron **27.** Night Blindness
28. 9 Kilo Calories **29.** Hydrochloric acid **30.** Carbohydrates **31.** ileum
32. egestion **33.** Calcium for bones and iron for blood **34.** Liver
35. Scurvy **36.** Small intestine **37.** HCl **38.** wheat brans
39. anemia **40.** B **41.** Vitamin K **42.** C **43.** 1.5 Kg
44. Buqrat **45.** Magnesium

☆ Give short answer to the following questions.

1. Define macronutrient with example.
(LHR. GI, MLN. GII, DGK. GI & GII, BWP. GI, GRW. GII, SWL. GI)

Ans: The nutrients which are required in large quantities are called macronutrients.
Examples: Carbon, hydrogen, oxygen, nitrogen, magnesium, potassium etc.

2. Write name of diseases due to the deficiency of vitamin D.
(LHR. GII, SGD. GI, RWP. GI, DGK. GII)

Ans: Deficiency of vitamin D cause rickets and osteomalacia.

3. Write the main food sources of proteins in human diet. (LHR. GII, MLN. GII)

Ans: Following are the main food sources of proteins are meat, eggs, grains, legumes, dairy products milk and cheese.

4. Which are inorganic fertilizers? (LHR. GII)

Ans: Those fertilizers which are first available from soil to plant for up take are known as inorganic fertilizers.

5. Describe the role of iron and boron in plant's life. (GRW. GI, SWL. GI)

Ans: Iron: Iron is necessary for photosynthesis, activates many enzymes.
Boron: Boron is important in sugar transport, cell division, and formation of certain enzymes.

6. What is meant by tetany? (GRW. GI)

Ans: Automatic releasing of nerve impulse due to lack of calcium is called tetany.

7. From what sources we get vitamin C? (GRW. GI)

Ans: Citrus fruits (e.g. oranges, lemons, and grape fruit), leafy green vegetables, beef liver are best source of vitamin C.

8. What is sphincter? Describe its types. (GRW. GI, MLN. GI)

Ans: The Role whose opening and closing is controlled by muscles are called sphincter.

Types of sphincter: ☆ Cardiac sphincter ☆ Pyloric sphincter

9. What is meant by mastication? (GRW. GII)

Ans: Grinding of food with the help of teeth in oral cavity is called mastication.

10. Define appendix. (GRW. GII)

Ans: From the blind end of caecum there arises a non-functional finger-like projection called appendix.

11. Define villi. (GRW. GII, SWL. GII)

Ans: Circular folds in the inner walls of the ileum which have numerous finger like projections are called villi.

12. Write the role of magnesium in plants. (FBD. GI)

Ans: Role of magnesium:

1. Magnesium is a structural component of chlorophyll.
2. It is necessary for functioning of plant enzymes to produce carbohydrates, sugars and fats.

Magnesium is used for fruit and nut formation and essential for germination of seeds.

13. Differentiate between major minerals and trace minerals. (FBD. GI)

Ans: Major minerals: Minerals that are required in amounts of 100mg (milligrams) or more per day are called Major minerals.

Trace minerals: Minerals which are required in amounts less than 100mg (milligrams) per day are called Trace minerals.

14. Define balanced diet. (FBD. GI, MLN. GII, RWP. GII, DGK. GII)

Ans: A diet which contains all the essential nutrients like carbohydrate, fats, proteins, minerals and vitamins in the correct proportion for the normal growth and development of the body is called balanced diet.

15. What is meant by chyme? (FBD. GI)

Ans: Partially digested soup like mixture which enters from stomach to duodenum is called chyme.

16. What is meant by nutrients? (FBD. GII)

Ans: The elements or compounds that an organism obtains for energy or for synthesis new materials are called nutrients.

17. Write two adverse affect of carbonated soft drinks. (FBD. GII)

Ans: Carbonated soft drinks are highly acidic, which cause deficiency of oxygen in blood. Excess of soft drink cola, cause stomach ulcer.

18. Differentiate between Assimilation and Absorption. (MLN. GI)

Ans: Assimilation: Conversion or incorporation of absorbed simple food into the complex substances constituting the body is called assimilation.

Absorption: Diffusion of digested food into blood and lymph is called absorption.

19. Write down the weight and size of liver of an adult human. (MLN. GI)

Ans: The weight of liver is 1.5kg and its size is of a foot balls.

20. Define Churning. (MLN. GI)

Ans: In stomach food is further converted in to small pieces due to contraction and relaxtion of stomach wall. This is called churning.

21. Describe two main types of Fertilizers. (MLN. GII)

Ans: Fertilizers are of two types:

Inorganic fertilizer: Those fertilizers which are available from soil to the plant for up take are inorganic fertilizers.

Organic fertilizer: Fertilizers which take time to be broken down into forms usable by plants due to their complexity are called organic fertilizer.

22. Describe any two functions of liver beside digestion. (SWL. GI, BWP. GII)

Ans: 1. Liver removes amino groups from amino acids (de-amination)

2. It also converts ammonia to a less toxic form i.e. urea.

23. What is the difference between bolus and chyme?

(SWL. GI, SGD. GI, LHR. GII, RWP. GI & GII, BWP. GII)

Ans: Bolus: During the processes of chewing, lubrication and semi-digestion, the pieces of food are rolled up by the tongue into small, slippery, spherical mass called bolus.

Chyme: The starch in our bite of bread and the protein in mutton have been partially digested and the food has been converted to a soup-like mixture called chyme.

24. What are the major causes of ulcer? (SWL. GI, LHR. GI, RWP. GI)

Ans: Following are the major Causes of ulcer:

1. Excess acid
2. Infection
3. Long term use of anti-inflammatory medicines (e.g. aspirin)
4. Smoking
5. Drinking coffee
6. Drinking colas
7. Eating spicy food

25. Write down briefly the role of water in human body. (SWL. GII, LHR. GII)

Ans: Water is major component in human body. It is basic need of man, all the bio chemical reactions are occurring in presence of water in blood plasma water is the main component, with out the presence the existing of life will be impossible.

26. What are water soluble vitamins? Write down their names. (LHR. GI, SGD. GI)

Ans: The vitamins that are soluble in water are called water soluble vitamins.

Examples: Vitamins B and vitamins C are water soluble vitamins.

27. Write down two types of stomach ulcer. (SGD. GI)

Ans: Following are two type of stomach ulcer.

☆ Gastric ulcer ☆ Duodenal ulcer

28. Define nutrition. (SGD. GII, DGK. GI, BWP. GI)

Ans: The process in which food is obtained or prepared, absorbed and converted into body substances for growth and energy, is called nutrition.

29. What is the function of saturated fatty acids in human body? (SGD. GII)

Ans: They provide energy to human body and fulfill the required nutrients. The great source of human food is consist on saturated fatty acids.

30. Define dehydration. (SGD. GII)

Ans: Lack of water in body is called dehydration, this is cue to shortage of water or excess removal of water in the form of water.

31. Write three parts of large intestine. (SGD. GII, LHR. GII)

Ans: Large intestine have following parts.

☆ Caecum ☆ Colon ☆ Rectum

32. Which is the largest gland of human body and where it is located? (RWP. GI)

Ans: Liver is the largest gland of body. It lies beneath the diaphragm of right side of abdomen.

33. What are the main causes of constipation? (RWP. GI, SGD. GI)

Ans:
1. Excessive absorption of water through colon.
2. Insufficient intake of dietary fibre.
3. Dehydration.
4. Use of medicines containing iron, calcium and aluminium.
5. Tumours in the rectum or anus.

34. How the deficiency of vitamin A causes blindness? (RWP. GI)

Ans: Vitamin A combine with a protein called opsin to form rhodopsin in rod cells of retina of eye. When vitamin A is inadequate, the lack of rhodopsin makes it difficult to see in dim light, which result in blindness.

35. Deficiency of which Vitamin causes Osteomalacia? Write down one symptom. (RWP. GII)

Ans: Lack of vitamin D cause osteomalacia in which bones become soft.

36. Why full grain bread is better than white bread? (RWP. GII)

Ans: Full grain bread is better than white bread because it contain more dietary fibers.

37. Define malnutrition. (RWP. GII, MLN. GI)

Ans: Malnutrition is a term for the condition caused by an improper or insufficient diet.

38. Define fertilizers. (DGK. GI & GII)

Ans: Materials which are added to soil resulted in plants with desirable characteristics (e.g more fruit, faster growth, better color, more attractive flowers) are called

fertilizers.

39. Write the function of liver in digestive system. (SWL. GII, DGK. GII)

Ans: Liver secrete bile, which is stored in gall bladder when gall bladder contracts bile is released in to duoderum through common bile duct. Bile has no enzyme but contains bile salt for emulsification of lipids. It help the lipid digesting enzymes to attack on lipids.

40. Write the role of Calcium and Potassium in Plants Life. (BWP. GI)

Ans: Calcium: Activates enzymes, is a structural component of cell wall, influences water movement in cells.

Potassium:

☆ Regulates the opening and closing of the stoma.
☆ Reduces water loss from the leaves.

41. Differentiate between Saturated and Unsaturated Fatty Acid. Give one example of each. (BWP. GI, FBD. GII, LHR. GI, SGD. GII)

Ans: Saturated fatty acids: Saturated fatty acids have all of their carbon atoms bonded to hydrogen atoms.

Example: Butter.

Unsaturated fatty acids: The fatty acids which have some of their carbon atoms double-bonded in place of a hydrogen atom.

Example: Sunflower oil.

42. Describe the function of Vitamin D. (BWP. GII)

Ans:
- The best-known function of vitamin D is to help regulate blood levels of calcium and phosphorous.
- Vitamin D increases absorption of these minerals from the intestine and their deposition in bones.

43. Describe the reason of disease Goiter. Also write its effects on body. (BWP. GII)

Ans: Reason: Goiter is a condition caused by an insufficient amount of lodine in diet. lodine is used by thyroid gland to produce hormone that control the body normal functioning and growth.

Effects: If sufficient iodine is not available in a person diet thyroid gland become enlarged and it results in swelling the neck.

44. Describe the function of Pepsin in Stomach. (BWP. GII)

Ans: Pepsin is a powerful protein digesting enzyme. It is released in active form, pepsinogen, it requires HCl for its activation.Pepsin partially digest the protein portion of food (bulk of mutton) in to polypeptides and shorter peptides chains.

45. What are the sources of vitamin-D? (LHR. GI)

Ans: Vitamin D is found in fish liver, oil, milk, ghee and butter. It also prepared by our skin when sun light fall on it.

46. What is the function of iron and calcium in human diet? (LHR. GI)

Ans: In human body iron is used to transport and storage of O_2, while calcium is used for development and maintenance of bones and teeth. It also help in blood clotting.

47. What is diarrhoea? Write its two causes. (LHR. GI)

Ans: The condition in which the patient has frequent watery, loose bowel movements is called diarrhoea.

Causes: (1) It is caused by bacterial infection of large intestine.

(2) The main cause of diarrhoea includes lack of adequate safe water.

48. Write the symptoms of diarrhoea and constipation. (LHR. GII)

Ans: Symptoms of diarrhoea: The patient has abdominal pain, nausea and vomiting.

Symptoms of constipation: In constipation a person experiences hard faeces, that is difficult to eliminate.

49. Write the role of phosphorus and zinc in plants. (GRW. GI)

Ans: Phosphorus: It is necessary for seed germination, photosynthesis and protein formation.

Zinc: It is required in a large number of enzymes.

50. What are the causes of anemia and goiter diseases in man? (GRW. GI)

Ans: Cause of Goiter: Goiter is caused by an insufficient amount of iodine in the diet.

Cause of Anemia: The condition is caused by the deficiency of iron when the number of red blood cells is reduced than the normal. Haemoglobin molecule contains a single atom of iron at its center. If body fails to receive sufficient amounts of iron, an adequate number of haemoglobin molecules are not formed. In this case, there are not enough functioning red blood cells.

51. Write the names of two juices secreted in small intestine of man. (GRW. GI)

Ans: Following are two juices secreted in small intestine of man.

☆ Pancreatic juice ☆ Bile Juice

52. Write the role of dietary fibres in human diet. (GRW. GI, LHR. GI & GII, MLN. GII)

Ans: Fibre prevents and relieves constipation reduces the risk of many other diseases. Soluble fibre helps in lowering blood cholesterol. Insoluble fibre speed up the movement of carcinogens.

53. What is the role of phosphorus in living organisms? (GRW. GII)

Ans: Phosphorus: It is component of ATP, nucleic acid and enzymes, necessary for seed germination, photosynthesis, protein formation etc.

54. What is meant by protein? (GRW. GII)

Ans: Proteins are composed of amino acid. Proteins are essential components of the cytoplasm, membranes and organelles. Many proteins play role as enzymes proteins can also used for gaining energy. One gram of protein contains 04 kilocalories of energy.

55. Write briefly the role of oral cavity. (GRW. GII)

Ans: Oral cavity is space behind mouth and has many important functions.

- ☆ Selection of food is very important function of oral cavity. The sense of smell and taste help the oral cavity. Grinding of food is also carried out by oral cavity.

56. Write the role of potassium and calcium in man. (FBD. GI, MLN. GI)

Ans: Potassium: It act as fluid balance in body, also acts as cofactor for enzyme, important for muscle contraction.

Calcium: It play vital role in development and maintenance of bones and teeth, also for clotting.

57. Write the names of two diseases due to protein energy malnutrition. (FBD. GI)

Ans: Following two diseases are caused due to protein energy malnutrition.

- ☆ Kwashiorkor
- ☆ Marasmus

58. What problems are caused by over intake of vitamin A and D? (FBD. GII)

Ans: Vitamins are required in low amounts. Excess amount of vitamin A cause loss of appetite and cause liver problems. Excess amount of vitamin D cause deposition of calcium in tissues. It also cause pains in bones and stone in kidney.

59. What is obesity? Why it is called the mother of diseases? (FBD. GII)

Ans: Obesity means becoming over weight and it may also due to malnutrition. People who take food more than their requirements and do very little physical work become obese. It is known as mother disease and leads to heart problems, hypertension and diabetes.

60. From where bile secretion is produced? Write its funciton. (FBD. GII)

Ans: Liver secrete a juice known as bile. It helps in digestion of lipids.

61. Which diseases are caused due to deficiency of Vitamin "A"? (MLN. GI)

Ans: Deficiency of vitamin A cause night blindness and dry and damage texture of skin.

62. Differentiate between Pepsin and Pepsinogen. (MLN. GII)

Ans: Gastric juice contain a protein digesting enzyme known as pepsinogen, while active form of pepsinogen is know as pepsinogen. Pepsinogen required HCl to convert it in active form.

63. What is meant by Vitamins? Write down their types. (DGK. GI, MLN. GII)

Ans: Those chemical compounds which are required in small amount but essential for normal growth and metabolism are called vitamins.

Types of Vitamins:

There are two types of vitamins:

- ☆ Fat soluble vitamin
- ☆ Water soluble vitamin

64. What is the role of Pancreas in Digestion? (MLN. GII)

Ans: Pancreas secrete pancreatic juice containing enzymes.

i.e trypsin, pancreatic amylase and lipase which is used to digest protein, carbohydrates and lipids respectively.

65. Differentiate between autotrophic and heterotrophic organisms. (SWL. GI)

Ans: Those organism which can prepare their own food are called autotrophs, while those which can not prepare their food and depends upon other for their food are known as heterotrophs.

66. What is eutrophication? What is its effect on earth? (GRW. GII, SWL. GI, SGD. GII)

Ans: Definition: The increase in chemical nutrients in an ecosystem is called eutrophication.

Effects: The high solubilities of fertilizers degrade ecosystems through eutrophication.

67. Define peristalsis. (SWL. GII)

Ans: The wave like movement of muscles that pushes food in digestion process is called peristalsis.

68. Give the role of bile in digestion. (SWL. GII)

Ans: Bile from liver helps in digestion of lipids by emulsification.

69. Which disease occur due to deficiency of vitamin "C" from which source we get this vitamin? (SGD. GI)

Ans: Deficiency of vitamin C cause scurvy. We get vitamin C from citrus fruit e.g oranges, lemons and grape fruit.

70. Name the part of Human Alimentary Canal. (SGD. GI)

Ans: The main parts of alimentary canal are oral cavity, pharynx, oesophagus, stomach, small intestine and large intestine.

71. Define ingestion and digestion. (SGD. GI)

Ans: Ingestion: The process of intake of food is called ingestion.

Digestion: The process of breaking up complex substances into simpler substances is called digestion.

72. Write the symptoms of goiter and Anaemia. (SGD. GII)

Ans: In Goiter the thyroid gland become enlarged and it results in swelling of neck.

In anemia person become weak and there is shortage of oxygen supply to body cells.

73. What is meant by Drought? (RWP. GI, DGK. GI)

Ans: A drought is a period of time when there is not enough water to support agricultural and human needs. Drought is usually due to long period of below normal rainfall. Drought decrease or even stop the crop yields, which cause famine.

74. Write two reasons of stomach ulcer. (RWP. GI)

Ans: Major causes of stomach ulcer are excess acid, drinking coffee, and eating spicy food.

75. What is scurvy? Write down its symptoms. (RWP. GII)

Ans: Deficiency of vitamin C cause scurvy disease.

Symptoms: In this disease muscle and joints pain, bleeding from gums and skin become dry.

76. What is famine? **(DGK. GI)**

Ans: Lack of enough food to feed all people living in an area is known as famine. The major cause of famine are unequal distribution of food, drought, flooding or increasing population.

77. What is gastrin? **(DGK. GI)**

Ans: A hormone which enter in blood and then to all parts of body including stomach. It affects cells of gastric glands to secrete more gastric juice.

78. Write the role of macronutrient in plants. **(DGK. GII)**

Ans: Macronutrients play vital role in plant life.
Phosphorus is component of ATP, essential for photosynthesis, protein formation.
Potassium regulates the opening and closing of stomata.

79. Why carbohydrates are important for man? **(DGK. GII)**

Ans: Carbohydrates are the basic source of energy for all animals. About half to 2/3 of total calories every animal consumes daily are from carbohydrate. Carbohydrates is most common source of energy.

80. Write role of Calcium and Flouride in human body. **(BWP. GI)**

Ans: Calcium is used in development and maintenance of bone and teeth. While fluoride stabilizes bone mineral and hardens tooth of enamel.

81. Write sources and deficiency symptoms of Vitamin D. **(BWP. GI)**

Ans: Vitamin D is obtained from Fish liver oil, Milk, Ghee and butter synthesized by skin. deficiency of vitamin D cause rickets in children, osteomalacia in adults.

82. What is Anemia? How it is caused? **(BWP. GI)**

Ans: The term anemia literally means a lack of blood.
Cause: This is caused by deficiency of iron, when number of red blood cells is reduced than normal. Hemoglobin molecule contain a single atom of iron at centre if body fails to receive sufficient amount of iron an adequate number of haemoglobin molecules are formed. In this case there are not enough functioning red blood cells.

83. Differentiate between marconutrients and micronutrients. **(BWP. GII)**

Ans: The nutrients which are required in large quantities are called macro nutrients, while those which required in small quantities are called micro nutrients.

84. Write down a few lines on a disease Kwashiorkor. **(BWP. GII)**

Ans: In this disease children may grow to normal height but are abnormally thin. It is caused due to deficiency of protein at the age of 12 months when breast feeding is discontinued.

TRANSPORT

Major Concepts:

- **9.1- Transport in plant:**
  - 9.1.1- Water and ion uptake
  - 9.1.2- Transpiration
  - 9.1.3- Transport of water
  - 9.1.4- Transport of food
- **9.2- Transport in human:**
  - 9.2.1- Blood
  - 9.2.2- Human heart
  - 9.2.3- Blood vessels
  - 9.2.4- General plan of human blood circulatory system
- **9.3- Cardiovascular disorders:**
  - 9.3.1- Atherosclerosis and arteriosclerosis
  - 9.3.2- Myocardial infarction

Q.1. What is transportation in (ترسیل) organisms? Why it is important?

Ans: Transportation:

Definition: Transfer of materials in an organism from one place to another is called transportation.

In unicellular organisms:

In unicellular (یک خلوی) organisms transportation of materials is done by simple diffusion (تحلیل) because every corner of their body is in close and direct contact with the environment.

Transportation in multicellular organisms:

In complex multicellular bodies, cells are far apart (دور دور) from the environment and such bodies need a comprehensive (وسیع) system for the transport of materials.

Importance of transportation:

Transportation is very important because to run the complex metabolism of organisms, cells need some materials from the environment and also need to dispose some materials into the environment. For this purpose materials are transported to and from the cells. So transportation is important in their life.

9.1 TRANSPORT IN PLANTS

Q.2. How water is important for the transportation in plants?

Ans: Water is not necessary just for photosynthesis and turgor (پانی کے انجذاب کے سبب خلیوں کی تنی) but also most of the cellular activities occur in the presence of water.

Internal temperature of plant body is also regulated by water.

Water and transportation:

1. Land plants get water and minerals from the soil (زمین). After absorption by the roots, water and minerals have to be transported to the aerial parts (جو حصے ہوا میں ہوتے ہیں) of the body.
2. During photosynthesis food is manufactured in leaves. Now this prepared food is transported to the other parts of the plant through transportation.

All land plants (except from mosses and liverworts), have developed complex vascular systems that move water and food throughout the plant body. This vascular system consists of xylem and phloem tissues.

Q.3. How would you relate the internal structure of root with the uptake of water and salts?

Ans. Root:

Definition: Root is the underground (زیرِ زمین) part of plant, which absorbs water and minerals from the soil.

Functions of root:

Roots perform two vital (اہم) functions.

1. They absorb water and salts from the soil.
2. They provide conducting tissues for distributing these substances to the tissues of the stem (تنا).

Internal structure of root:

Internal structure of root consist of following parts.

1. ***Conducting tissues:***

Conducting tissues of root consists of xylem and phloem. They are grouped in the centre to form a rod-shaped (سلاخ نما) core, which extends throughout the length of the root.

2. ***Pericycle:***

Outside the conducting tissues there is a narrow (تنگ) layer of thin-walled cells called pericycle.

3. ***Endodermis:***

A single layer of cells that surrounds (گھیرے ہوتے ہیں) the pericycle layer called endodermis.

4. ***Cortex:***

The remaining tissues of the root consist of a broad zone of large and thin-walled

cells which called cortex.

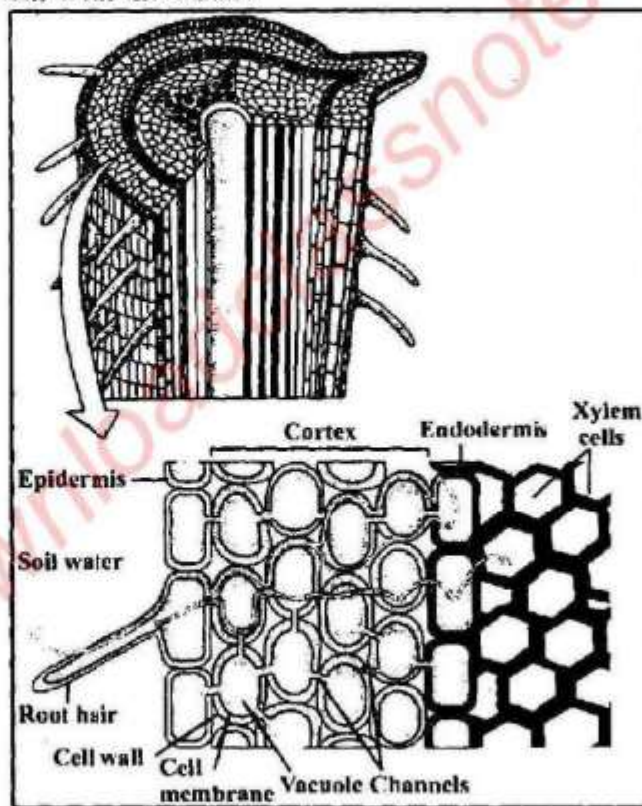
5. ***Epidermis:***

The cortex is bounded on the outside by a single layer of epidermal cells. Which makes epidermis.

6. ***Root hair:***

Root hairs are actually extensions (توسیع) of the epidermal cells. Roots have clusters (جھنڈ) of tiny root hairs.

Functions of root hair:

(i) They provide large surface area for absorption.
(ii) They grow out into the spaces between soil particles where they are in direct contact (براہ راست تعلق) with the water.

Uptake of water and ions by root

Phenomena for water absorption:

Root hairs have direct contact with water. The cytoplasm of the root hairs has higher concentration of salts than the soil water.

Water moves by the osmosis into the root hair.

Absorption of salts:

Salts enter root hairs by diffusion or active transport.

Water and ion intake:

When water and salts enter into the root hairs, they move through intercellular (خلیوں)

(کے درمیان) spaces or through cells and reach xylem tissue.

Water and ion uptake pathways:

Once in the xylem the water and salts can be carried to all the aerial parts of the plant.

Q.4. Define transpiration and relate it with cell surface and with stomatal opening and closing.

Ans. Transpiration:

Definition: The loss of water from plant surface through evaporation (عمل تبخیر) is called transpiration.

Modes of transpiration:

Transpiration takes place through different modes (طریقے).

1. Through stomata in leaves
2. Through cuticle on leaf epidermis
3. Through lenticels in the stems

In this chapter we will only study stomatal transpiration.

Stomatal transpiration:

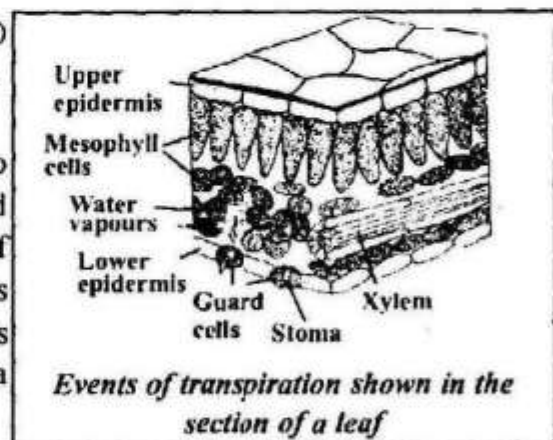
Definition: Most of the transpiration takes place through stomata and is called stomatal transpiration.

Explanation

Mesophyll cell of leaf provide (مہیا کرتا ہے) large surface area for the evaporation of water.

Mechanism:

Water is drawn from the xylem into mesophyll cells, from where it comes out and makes a water-film (پانی کی تہہ) on the cell walls of the mesophyll. From here, water evaporates into the air spaces of the leaf. Water vapours then diffuse from air spaces towards stomata and then pass to outside air.

Events of transpiration shown in the section of a leaf

Opening and closing of stomata:

Observations about opening of stomata:

Following two conditions are observed by biologists.

1. Most plants keep their stomata open during the day and close them at night.
2. Some plants open their stomata during night when overall water stress is low.

Responsibility of stomata:

It is the responsibility (ذمہ داری) of stomata (باقاعدہ بنانا) to regulate transpiration via the actions of guard cells.

Structure of guard cells:

⇒ The two guard cell of a stoma are attached to each other at their ends (کناروں پر).

⇒ The inner concave sides of guard cells that enclose a stoma are thicker than the outer convex sides.

Opening of stoma:

When guard cells get water and become turgid, their shapes are like two beans and the stoma between them opens.

Closing of stoma:

When guard cells loose water and become flaccid (کمزور), their inner sides touch each other and stoma closes.

Previous Research:

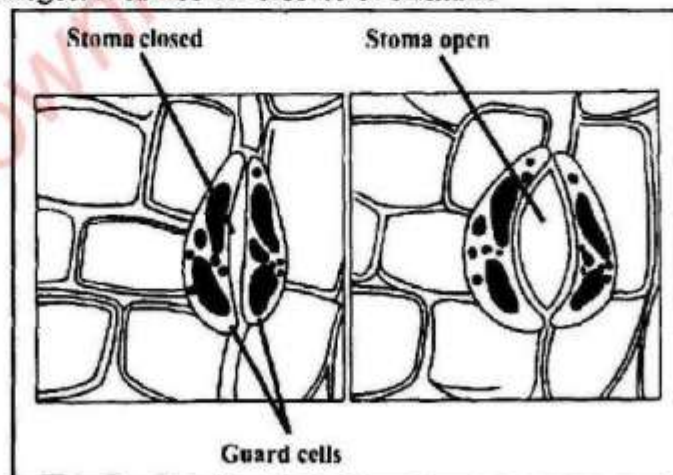
It has been studied that the concentration of solutes (glucose) in guard cells is responsible for the opening and closing of stomata.

Modern Research (جدید تحقیق):

Recent research have revealed this process as light causes the movement of potassium ions from epidermal cells into guard cells.

Water follows these ions and enters guard cells. Thus their turgidity increases and stoma opens.

Closing of stomata:

At the end of the day, potassium ions flow back from guard cells to epidermal cells and the concentration of glucose also falls. Due to it, water moves to epidermal cells and guard cells loose turgor. It causes the closure of stomata.

Opening and closing of stoma

Q.5. How do different factors affect the rate of transpiration?

Ans: Factors which affect the rate of transpiration (بخارات خارج کرنا) are given below.

1. Light:

Transpiration depends upon light. In strong light the rate of transpiration is very

high as compared to dim light (کم روشنی) or no light.

2. Temperature:

Increased rate of transpiration:

High temperature reduces the humidity (نمی) of the surrounding air and also increases the kinetic energy of water molecules. In this way it increases the rate of transpiration.

The rate of transpiration doubles with every rise of 10°C in temperature.

Decreased rate of transpiration:

At very high temperatures i.e. 40-45°C cause closure of stomata. So, transpiration stops and plant does not loose the much needed water.

3. Humidity:

Transpiration in dry air:

When air is dry (خشک), water vapours (بخارات) diffuse more quickly from the surface of mesophyll cells into leaf air spaces and then from air spaces to outside. This increases the rate of transpiration.

Transpiration in humid air:

In humid air the rate of the diffusion of water vopours is reduced and the rate of transpiration is low.

4. Air movement:

Wind carries away (لے جاتی ہے) the evaporated water from leaves and it causes an increase in the rate of evaporation from the surfaces of mesophyll. When air is still (ساکن), the rate of transpiration is reduced.

5. Leaf Surface area:

Rate of transpiration depends (انحصار کرتا ہے) upon the surface area of leaf. More surface area provides more stomata and there is more transpiration.

Q.6. Transpiration is a necessary evil. Give comments.

Ans: Transpiration is called a necessary evil (ایک ضروری بری چیز). It means that transpiration is a potentially harmful process but is unavoidable too.

Significance of transpiration:

Harmful effects (نقصان دہ اثرات) of transpiration:

Transpiration may be harmful process in the sense that during drought conditions loss of water from the plant results in wilting (مرجھانا), serious desiccation (خشک ہونا) and often death.

Benefits of transpiration:

Transpiration is necessary too.

(i) It creates a pulling force called **transpirational pull**, which is principally (اصولی طور پر) responsible for the conduction of water and salts from roots to the aerial parts of the plant body.

(ii) When water transpires from the surfaces of the plant, it leaves a cooling effect on

plant. This is especially important in warmer environments (گرم ماحول).

(iii) The wet surfaces of leaf cells allow gaseous exchange.

Q.7. Observe the stomata on the epidermal peel of a leaf and describe their structure and number.

Ans: Stomata are the microscopic pores (خوردبینی مسام) in the epidermis of leaves. They are the passageways (راستے) for gases and water vapours.

Background information:

- A stoma is an opening for removal of gases and water.
- Each stoma is surrounded by two bean-shaped guard cells.
- The epidermis of leaves has stomata among its epidermal cells.

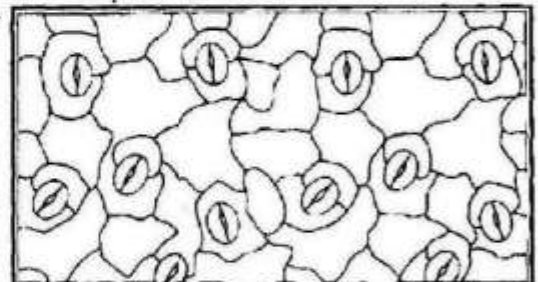
Apparatus required

Petri dish, water, glass slides, cover slips, methylene blue, light microscope.

Procedure:

1. Take a thick leaf and peal off (اتارلیں) a thin layer (epidermis) from its surface.
2. Place the thin layer in water in a petri dish.
3. Cut a piece of the peeled off epidermis and place it in a drop (قطرہ) of water on a glass slide.
4. Pour a drop of methylene blue and place a cover slip on the material.
5. Observe under the low and high powers of the microscope.

Observation:

Observe the epidermis and point out the stomata present in it. Count the total stomata and count how many of these are open. Draw observation (مشاہدہ) on note book.

Microscopic view of the epidermis of a leaf

Evaluation:

(i) How many stomata did you observe?

Ans. Twelve stomata are observed.

(ii) What is the structure of guard cells and how does it help in the opening and closing of stomata?

Ans. The guard cells are of bean shaped. The inner concave sides of guard cells that enclose a stoma are thicker (موٹی) than the outer convex side.

- When guard cells get water and become turgid, shapes are like beans and the stoma between them opens.
- When guard cells loose water and become flaccid, their inner sides touch each other and stoma closes.

Q.8. Explore the occurrence of transpiration.

Ans: Occurrence of transpiration can be investigated by observing transpiration in potted plant (گملے والا پودا).

Apparatus: A potted plant, 2 bell jars, polythene bag, copper sulphate.

Hypothesis:

Transpiration occurs in plants which are given adequate (کافی) supply of water and are placed in light.

Background information:

- Transpiration is the loss of water from plant surface (سطح).
- Polythene bag stops the escape of (فرار) water vapours.

Deduction:

A plant placed in light would transpire and water vapours can be observed.

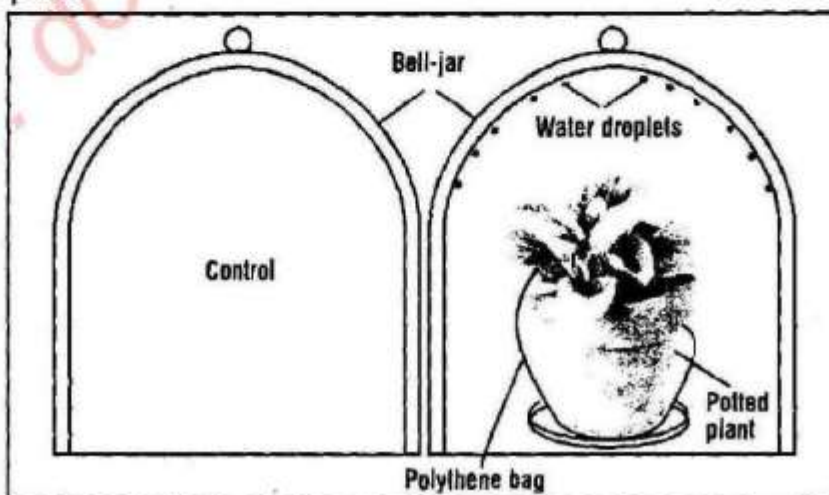
Procedure:

1. Take a potted plant and cover the pot and base of stem with polythene bag.
2. Place the potted plant on a glass plate and invert (الٹا کرکے رکھ دیں) a dry bell-jar over the pot and plant.
3. Leave the apparatus in sunlight.
4. Set up a control experiment with no plant.

Observation

After an hour, drops of colourless (بے رنگ) liquid are seen inside the bell-jar with the plant.

To show that these drops are of water, touch them with anhydrous copper sulphate (white) and its colour changes to blue.

On the other hand no drops of water are found in the control experiment where there was no plant.

Experiment set up for transpiration in potted plant

Results:

The water droplets on the inside of the jar containing the plant came from the leaves because the rest of the plant body and the soil were covered with polythene bag. Thus the potted plant present in the bell-jar showed the phenomenon of transpiration.

Q.9. Explore the pathway adopted by water during its transport in the stem.

Ans: ***Investigation of the pathway of water in a cut stem (کٹا ہوا تنا):***

The transport of water and salts from root to the aerial parts of the plant body is termed as the ascent of sap.

Background information:

⇒ Xylem tissue consists of vessel elements and tracheids. Vessel elements form long tubes while tracheids are long cells with overlapping (اوپر تلے) ends.

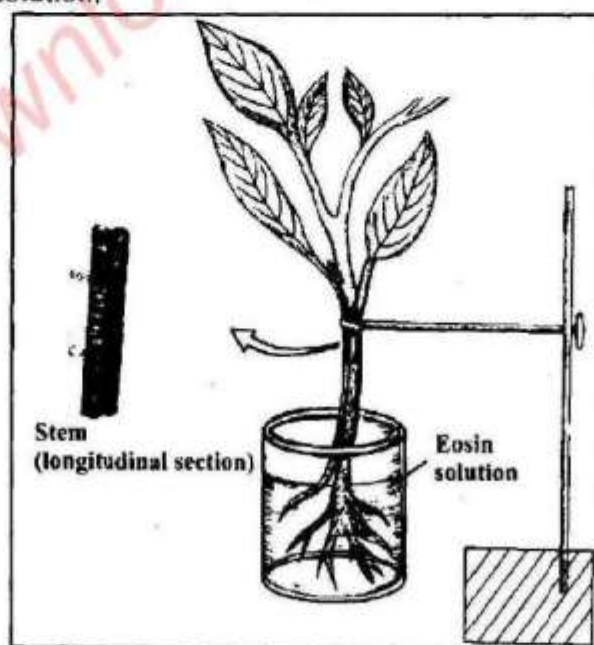
⇒ Transpirational pull is the major force responsible for the ascent of sap.

Hypothesis: Water moves through the xylem tissue of stem.

Deduction:

If a plant is given water with some stain (رنگدار) added, the transverse section of stem will show the same colour in the xylem region

Procedure:

1. Fill a beaker with dilute eosin solution.
2. Place the shoot of a herbaceous plant (e.g. white coloured Petunia) inside the beaker as shown in the figure. The lower end of the shoot must be completely submerged (ڈوبی ہوئی) in the solution.

Experimental set up to explore the pathway of water

3. Keep the apparatus for a night.

4. Cut the longitudinal sections of stem. Examine and observe it under microscope.

Observation:

The white stem of the plant will show red lines. When examined under the light microscope, the longitudinal (طولی وار) section of stem will also show that xylem portions have become red.

Results:

The water along with the red eosin stain was absorbed (جذب کرلیا) by the stem and was transported through xylem tissues.

Q.10. Explore the difference (فرق) in the rate of transpiration at the two surfaces (سطحیں) of a leaf.

Ans: ***Investigation of the rate of transpiration at the two surfaces of a leaf:***

The leaves have different rates of transpiration (rates of water loss) from the upper and lower surfaces.

Apparatus required:

A potted plant, cobalt chloride filter papers, forceps, glass slides, rubber bands, filter paper discs.

Background information:

⇒ Cobalt chloride paper is blue when dry and it turns pink when it comes in contact with water vapours (آبی بخارات).

⇒ The leaves of terrestrial plants have more stomata on their lower surface as compared to the upper ones.

Hypothesis:

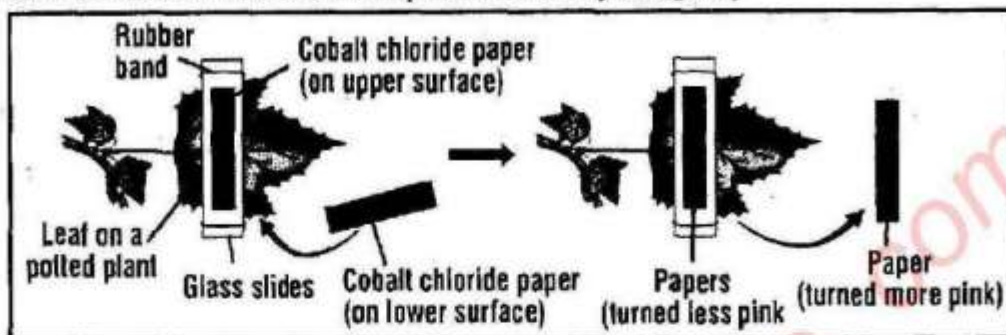
There is more transpiration from the lower surface of leaf as compared (مقابلتاً) to the upper one.

Deduction:

If there is more transpiration from the lower surface (نچلی), the cobalt chloride paper placed on the lower surface will show more colour change as compared to the paper place on the upper surface.

Procedure:

1. Prepare dry cobalt chloride papers. For this, treat filter paper discs with the slightly acidic solution of cobalt chloride and dry the treated discs. Now, the dark blue (گہرا نیلا) filter paper discs will be called cobalt chloride paper.
2. Take a potted plant. Water the plant and leave it for an hour.
3. Take two equal size cobalt chloride papers and with the help of forceps place one piece of cobalt chloride paper on the upper surface and the other paper on the lower surface of a leaf.
4. Place dry glass slides on the upper and the lower cobalt chloride papers and fix them with a rubber band. (The glass slides will prevent the cobalt chloride papers to

come in contact with the atmospheric humidity.(ماحولیاتی نمی)

Experiment to explore the rate of transpiration on the two surfaces of a leaf

Observation:

Note the changes in the colour of the two cobalt chloride papers. Both papers will start turning pink. The paper placed at the lower surface of the leaf takes less time (کم وقت) in turning pink.

Results:

The cobalt chloride paper placed on the lower surface of the leaf contacted more water as compared the paper placed on the upper surface. It means that there is more water loss (transpiration) from the lower surface of the leaf.

Reason: The reason is that leaves have more stomata on their lower surfaces.

Evaluation:

(i) **What does it show when the blue cobalt chloride paper starts turning pink?**

Ans. Cobalt chloride paper starts turning pink when it comes in contact with water vapours. It shows that transpiration is taking place.

(ii) **What is the relationship (تعلق) between the rate of transpiration and the number of stomata?**

Ans. The more the number of stomata, the rate of transpiration will be high and vice versa. As lower surface of a leaf has greater number of stomata, so the rate of water loss (transpiration) is greater at lower surface.

Q.10. Explain the movement of water in terms of transpirational pull.

Ans: ***Movement of water is plants:***

The process by which water is raised to considerable heights (بلندی) in plants has been studied for years in botany. The result of this research is **cohesion-tension theory.**

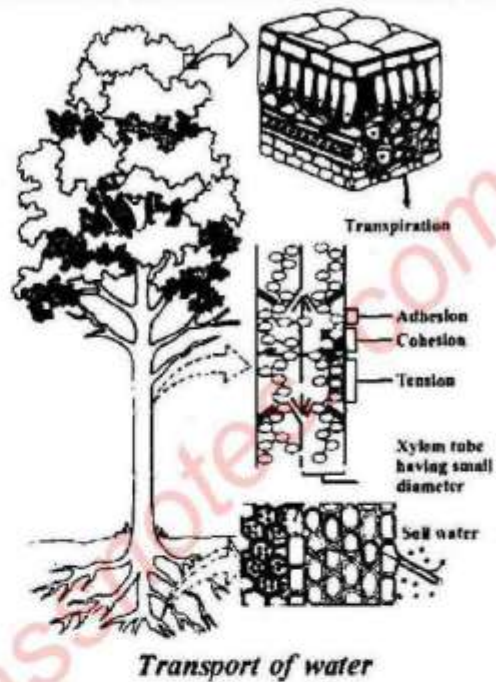
Cohesion-Tension theory or Transpiration pull:

According to this theory, the force which carries water upward through the xylem is transpirational pull.

Reason: Transpiration creates a pressure (دباؤ) difference that pulls water and salts up from the roots.

Mechanism:

When a leaf transpires or loses water, the water concentration of its mesophyll cells drops. This drop causes water to move by osmosis from the xylem of leaf into the mesophyll cells. When one water molecule moves up in the xylem of the leaf, it creates a pulling force that continues all the way to the root. This pulling force (کھینچنے والی طاقت) created by the transpiration of water is called transpirational pull. It also causes water to move transversely (آرپار) (from root epidermis to cortex and pericycle).

Transport of water

Reasons of transpirational pull:

Here are some reasons for the creation of transpirational pull.

1. Water is held in a tube called xylem that has small diameter.
2. Water molecules adhere to the walls of xylem tube (adhesion).
3. Water molecules cohere to each other (cohesion)

These attractions make an overall tension among water molecules and form 'columns' of water. The columns of water move from root to shoot and the water content of the soil enters in these column.

Q.11. Describe the theory of pressure flow mechanism to explain the translocation of food in plants.

Ans. Translocation (نقل مکانی) of food in plants:

Phloem is responsible for transporting food substance throughout the plant.

Food of plant:

The glucose formed during photosynthesis in mesophyll cells, is used in respiration and the excess of it is converted into sucrose. In most plants, food is transported in the form of sucrose.

As with water movement in plants, the movement of food in plants has been studied for years. The currently (حالیہ) accepted (تسلیم کی گئی) hypothesis states that the transport of food is through **pressure-flow mechanism**.

Pressure-flow mechanism:

In pressure-flow mechanism the food is moved from sources to sinks.

Sources:

Sources include the exporting organs, typically a mature leaf (صحت مند پتہ) or storage

organ.

Sinks: Sinks are the areas of active metabolism or storage.

Examples: Roots, tubers, developing fruits, leaves and all the growing regions.

Storage organ: It is capable of storing food and exporting (دوسری جگہ بھیجنا) the stored materials.

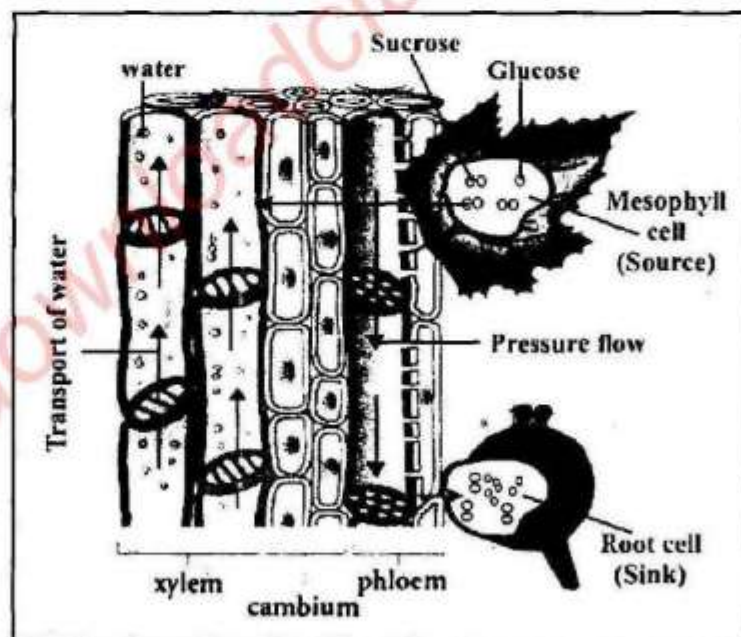
Examples:

Root of beet (چقندر) is a sink in first growing season, but becomes source in the next growing season, when sugars are utilized in the growth of new shoots.

Movement of food at the source:

At the source, the food (sugars) is moved by active transport into the sieve tubes of phloem. Due to the presence of sugar in sieve tubes, their solute concentration increases and water enters them from xylem via osmosis. This results in higher pressure of water in these tubes, which drives the solution of food towards the sink.

Movement of food at the sink end:

At the sink end, the food is unloaded by active transport. Water also exits (خارج ہوتا ہے) from the sieve tubes. The exit of water decreases the pressure in sieve tubes, which causes a mass flow from the higher pressure at the source to the now lowered pressure at the sink.

Transport of Food

9.2 Transport in Human

Q.12. What are the transport systems in higher vertebrates?

Ans: All higher vertebrates including man have very complex transport system.

Their transport system consists of two complex systems.

1. Blood circulatory system (نظامِ دورانِ خون)
2. Lymphatic system. (لمفی نظام)

The two systems are well coordinated (ملے ہوئے) and associated with each other.

Components of blood circulatory system:

Main components of human blood circulatory system are blood, heart and the blood vessels.

Closed circulatory system:

Like other vertebrates, humans have a closed blood circulatory system (meaning that blood never leaves the network of arteries, veins and capillaries).

Q.13. What is the composition of the blood. List the functions of the components of blood.

Ans: Blood:

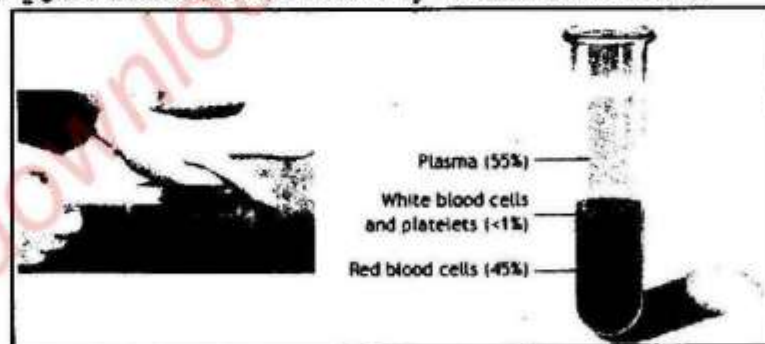
It is a specialized body fluid, considered a specialized form of connective tissue.

Composition of blood:

Blood is composed of a liquid called blood plasma and blood cells.

The weight of blood in our body is about 1/12th of our body. The average (اوسط) adult has about 5 litres of blood.

Ratio of plasma and blood cells:

In a healthy person, plasma constitutes about 55% by volume of the blood, and cells or cell-like (خلیوں جیسے اجسام) bodies are about 45% by volume of the blood.

Percentage composition of human blood

Blood Plasma:

Plasma is primarily water in which proteins, salts, metabolites and wastes are dissolved (حل ہوئے ہیں). Water constitutes about 90-92% of plasma, 8-10% are dissolved substances.

Composition of Plasma:

Plasma mainly composed of following:

1. ***Salts:***

The salts make up 0.9% of the plasma, by weight (وزن کے حساب سے).

⇒ Sodium chloride and salts of bicarbonate are present in considerable (کافی) amounts.

⇒ Ca, Mg, Cu, K and Zn are found in trace amounts.

⇒ The changes in the concentration of any salt can change the pH of the blood.

2. *Proteins:*

Proteins make 7-9% by weight of the plasma.

The important proteins present in plasma are antibodies, fibrinogen (blood clotting (جمانے والی) protein), albumin (maintains the water balance of blood) etc.

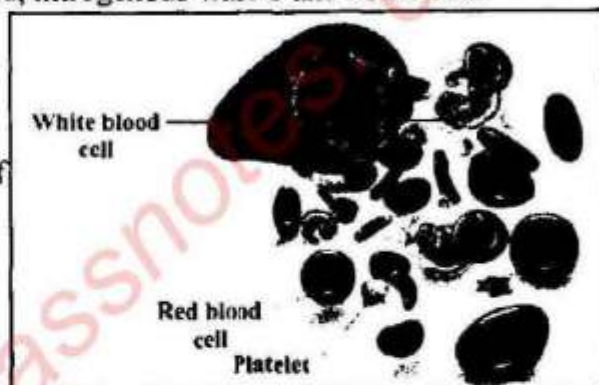
Some other substances:

⇒ Plasma also contains the digested food, nitrogenous wastes and hormones.

⇒ Respiratory gases i.e. CO_2 and O_2 are present in the plasma.

Blood cells:

Blood contains different types of cells that are.

1. Red blood cells or Erythrocytes.
2. White blood cells or Leukocytes.
3. Platelets or Thrombocytes.

1. Red blood cells (Erythrocytes):

These are the most numerous (بہت زیادہ) of blood cells.

Shape: RBCs are biconcave and have an elastic cell membrane.

Formation:

In the embryonic and foetal life (ابتدائی زندگی), they are formed in liver and spleen. In adults, they are formed in the red bone marrow of short and flat bones, such as the sternum, ribs and vertebrae.

Life of RBCs:

The average life span of RBC is about four months (120 days), after which it breaks down in liver and spleen by phagocytosis.

Amount of RBC in blood:

A cubic millimeter (مکعب ملی میٹر) of blood contains 5 to 5.5 million of RBCs in males, and 4 to 4.5 million in females.

Nucleus:

RBCs when formed have nucleus. In mammals (دودھ پلانے والے) when a red blood cell matures, its nucleus is lost. After the loss of nucleus, RBC enters blood.

About 95% of the cytoplasm of red blood cells is filled with hemoglobin, which transports oxygen and small amounts of carbon dioxide. The remaining 5% consists of enzymes, salts and other proteins.

2. White blood cells (Leukocytes):

Colour: These blood cells are colourless, as they do not contain pigments (رنگدار مادے).

They are not confined to blood vessels, as they also migrate out into the tissue fluid.

Amount in blood:

One cubic millimeter of blood contains 7000-8000 WBCs.

Life span:

They have life span of months to even years, but this depends on body's needs.

Types of white blood cells:

The two main types of WBCs.

1. Granulocytes 2. Agranulocytes

1. Granulocytes:

These are the leukocytes with granular cytoplasm. These include:

(a) Neutrophils (b) Eosinophils (c) Basophils

(a) Neutrophils:

They destroy small particles by phagocytosis.

(b) Eosinophils:

Break inflammatory (سوزش پیدا کرنے والے) substances and kills parasites.

(c) Basophils:

Basophils prevent blood clotting.

2. Agranulocytes:

These have clear cytoplasm and these include monocytes and lymphocytes (B & T lymphocytes).

(a) Monocytes:

Produce macrophages and engulf (گھیر لیتے ہیں) the germs.

(b) Lymphocytes:

Produce antibodies and kill germs.

3. Platelets (Thrombocytes):

They are not cells, but are fragments (ٹکڑے) of large cells of bone marrow, called megakaryocytes.

Nucleus: They do not have nucleus and any pigment.

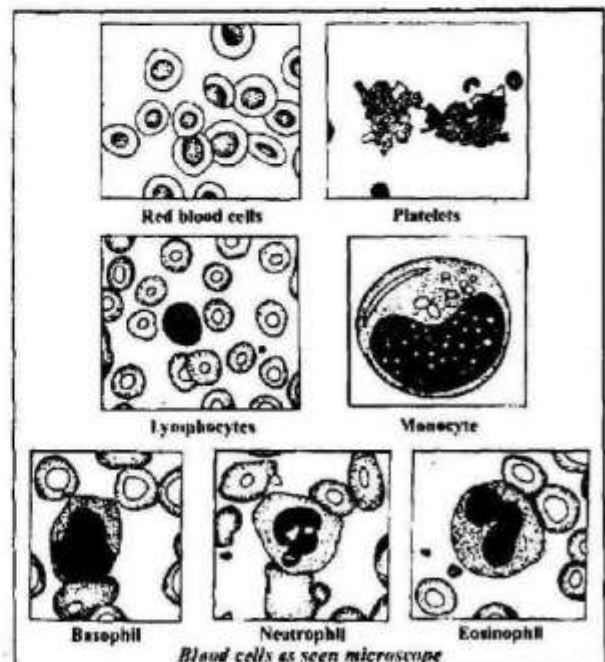
Amount in blood: One cubic millimeter of blood contains 250,000 platelets.

Life span: The average life span of a blood platelets is about 7-8 days.

Function: Platelets help in clotting.

The clot serves as a temporary seal at damaged area.

Red blood cells | Platelets | Lymphocytes | Monocyte | Basophil | Neutrophil | Eosinophil

Blood cells as seen microscope

Q.14. What are the disorders of blood?

Ans: There are many types of blood disorders (خرابیاں), including bleeding disorders, leukaemia, thalassaemia etc.

Leukaemia (blood cancer):

Leukaemia is the production of great number of immature and abnormal white blood cells.

Cause:

This is caused by a cancerous mutation (توارثی تبدیلی) in bone marrow or in the lymph tissue cells. This mutation results in uncontrolled production of defective (خراب) white blood cells (leukocytes).

Treatment:

It is a very serious disorder and the patient needs to change the blood regularly with the normal blood, got from donors (خون عطیہ کرنے والے).

It can by cured by bone marrow transplant which is effective in most cases, but very expensive (مہنگا) treatment.

Thalassaemia:

(Thalassa = sea; haem = blood).

Thalassa means sea and haem means blood.

Other name:

It is also calld Cooley's anaemia on the name of Thomas B. Cooley, an American physician.

Cause: It is caused by mutation in the gene of haemoglobin.

Symptoms:

The mutation results in the production of defective haemoglobin and the patient (مریض) cannot transport oxygen properly.

Treatment:

The blood of these patients is to be replaced regularly, with normal blood. It can be cured by bone marrow transplant but it does not give 100% cure rate.

Q.15. How do we classify blood groups in terms of the ABO and Rh blood group systems?

Ans: Blood group systems are a classification (درجہ بندی) of blood based on the presence or absence of antigens on the surface of red blood cells.

Antigens:

An antigen is a molecule that can stimulate an immune response (antibody production etc).

ABO Blood Group System:

Introduction:

It is the most important blood group system in humans. It was discovered (دریافت کیا)

by the Austrian scientist **Karl Landsteiner**. He found four different blood groups (blood types) in 1900. He was awarded the Nobel Prize in Medicine for his work.

Blood Groups:

In this system, there are four different blood groups which are distinct from each other on the basis of specific antigens present on the surface of RBCs.

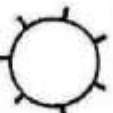
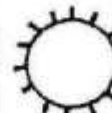
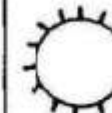
Types of Antigens:

Antigens are of two types

⇒ Antigen A ⇒ Antigen B

Blood group A: A person having antigen A has blood group A.

Blood group B: A person having antigen B has blood group B.

Blood group AB: A person having both antigens has blood group AB.

Blood Group O: A person having none (کوئی بھی نہیں) of the A and B antigens has blood group O.

Antibodies:

After birth, two types of antibodies i.e. anti-A and anti-B antibodies appear in the blood serum of individuals. These antibodies are present according to the absence (غیر موجودگی) of corresponding antigen.

Antibodies and blood groups:

⇒ In persons with blood group A, antigen A is present and antigen B is absent. So their blood will contain anti-B antibodies.

⇒ In persons with blood group B, antigen B is present and antigen A is absent. So their blood will contain anti-A antibody.

⇒ In persons with blood group AB, antigens A & B are present i.e. neither is absent. So their blood serum will contain no antibody.

⇒ In persons with blood group O, neither antigen A nor antigen B is present i.e. both are absent. So their blood serum will contain both antibodies i.e. anti-A and anti-B.

	Blood group A	Blood group B	Blood group AB	Blood group O
Red Blood Cells				
Antigens on RBCs	antigen A	antigen B	AntigenA&B	None
Antibodies in serum	Anti-B	Anti-A	None	Anti-A & Anti-B

Presence and absence of antigens and antibodies in ABO blood group system

Rh Blood Group System:

Introduction:

In 1930's Karl Landsteiner discovered the Rh-blood group system. In this system, there are two blood groups (1) Rh-postive (2) Rh-negative.-

Explanation:

Rh^- and Rh^- are distinct (مختلف ہیں) from each other on the basis of antigens called Rh factors.

Rh factor was first discovered in Rhesus monkey, present on the surface of RBCs.

A person having Rh factors has blood groups Rh-positive while a person not having Rh factors has blood group Rh-negative.

Unlike the naturally occurring anti-A and anti-B antibodies of the ABO-system, an Rh-negative person does not produce anti-Rh antibodies unless Rh-factor enters in his/her blood.

Q.17. Write down the composition of blood and major functions (بڑے بڑے کام) of its components (حصے) in the tabulated from.

Ans:

Composition of blood:

Plasma	Description	Amount in % age	Functions
	Liquid portion of blood	55% by volume	Carries blood cells and important blood proteins hormones, salts etc
CellTypes	**Description**	**Average Number present**	**Functions**
Red Blood Cells (Erythrocytes)	Like a biconcave disc; without nucleus; contain haemoglobin; 8um in dm	5,000,000 per mm^3	Transport Oxygen and a small amount of CO_2
White Blood Cells (Leukocytes)	Granular and agranular; contain nucleus; contain haemoglobin Larger in cells than RBCS	7500 per mm^3	Play role in body's defense by different ways like: Engulf small particles Release anticoagulants Produce antibodies
Platelets (Thrombocytes)	Fragments of bone marrow cells (megakaryocytes)	250,000 per mm^3	Involved in blood clotting

Q.17. What is meant by blood transfusions (انتقال) in ABO blood group system and in Rh blood group system?

Ans: ***Blood transfusion:***

It is the process of transferring blood or blood-based products from one person into the circulatory system of another.

Importance of blood transfusions:

Blood transfusions can be life-saving in some situations, such as massive blood loss due to injury, or can be used to replace blood lost during surgery.

People suffering from anaemia, haemophilia, thalassaemia or sickle-cell (موروثی قلت دم کا مرض) disease may require frequent blood transfusions.

Blood matching in transfusion in ABO blood group system:

Transfusion of blood is done after confirming (تصدیق کرنے کے بعد) that no **agglutination** (سوجن) results in the blood of recipient.

Harmful effect of agglutination:

If agglutination occurs, the clumped cells can not pass through capillaries.

For the confirmation of no agglutination, blood samples of donor and recipient are crossed-matched for compatibility (ہم آہنگی). Antibodies of the recipient's blood may destroy the corresponding antigen-containing RBCs of the donor or the antibodies of the donor's blood may destroy the antigen-containing RBCs of the recipient.

Blood Transfusion: Cross matching
✓ can be transfused
× agglutination

Donor Blood Groups \ Recipient Blood Groups	A	B	AB	O
A	✓	×	✓	×
B	×	✓	✓	×
AB	×	×	✓	×
O	✓	✓	✓	✓

Universal donors:

O blood group individuals are called universal donors (ہمہ گیر دہندے), because they can donate blood to the recipients of every other blood group.

Universal recipients:

AB blood group individuals are called universal recipients (ہمہ گیر وصول کنندہ), because they can receive transfusions from the donors of every other blood group.

Blood transfusions in Rh blood group system:

Rh-positive blood group can be transfused to Rh-positive recipient because recipient's blood already has Rh-antigens and it will not produce anti-Rh antibody. Rh-negative blood group can be transfused to Rh-negative because donor's blood does not have Rh-antigen and so recipient's blood will not produce anti-Rh antibody.

Mismatching of Rh-factor during transfusion:

If an Rh-negative person receives Rh-positive blood, he/she will produce anti-Rh antibodies against Rh-factors. Rh-negative blood can be transfused to Rh-positive recipient, only if donor's blood (Rh-negative) has never been exposed to Rh-antigens and does not contain any anti-Rh antibody.

Blood agglutination after a mismatching

Q.18. Write a detailed note on structure (ساخت) of human heart. What four chambers make the human heart and how blood flows through these chambers?

Ans: ***Human heart:***

The heart is a muscular (عضلاتی) organ responsible for pumping blood through the blood vessels by repeated contractions (سکڑنا).

Cardiac muscles:

The term cardiac means "related to heart". The bulk of the walls of the heart chambers is made of cardiac muscles.

Location of heart:

In the human-body, the heart is situated between lungs (پھیپھڑے), in the middle of the chest cavity (thorax) under breastbone.

Pericardium:

The heart is enclosed in a sac (تھیلی) known as the pericardium.

Pericardial fluid:

There is a fluid, known as pericardial fluid, between the pericardium and the heart walls.

Function:

Pericardial fluid reduces friction (رگڑ) between the pericardium and the heart, during heart contractions.

Structure of heart:

The human heart consists of four chambers (خانے).

Atrium:

The upper thin-walled chambers are called the left and right atria (singular 'atrium').

Ventricles:

The lower thick-walled chambers are called the left and right ventricles.

The left ventricle is the largest and strongest chamber in heart.

Function of heart:

Human heart works as a double pump i.e. it receives deoxygenated (with less oxygen) blood from body and pumps it to the lungs. At the same time, it receives

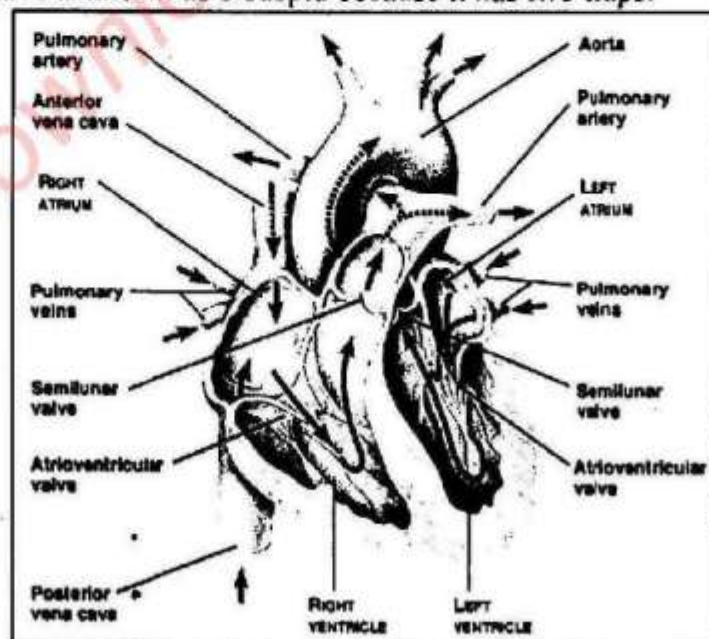
oxygenated (with more oxygen) blood from lungs and pumps it to all the body. Inside heart chambers the deoxygenated and oxygenated bloods are kept separated (علیحدہ).

Circulation of blood inside heart:

Deoxygenated blood:

1. The right atrium receives deoxygenated blood from the body via the main veins i.e. superior and inferior vena cavae.
2. When right atrium contracts it passes the deoxygenated blood to the right ventricle.
3. The opening between the right atrium and the right ventricle is guarded by a valve known as tricuspid valve.
   Tricuspid valve is called tricuspid because it has 3 flaps.
4. When right ventricle contracts, the blood is passed to pulmonary trunk, which carries blood to the lungs.
5. The tricuspid valve prevents the backflow (واپس جانا) of blood from right ventricle to the right atrium.
6. At the base of the pulmonary trunk, pulmonary semilunar valve is present which prevents the backflow of blood from pulmonary trunk to the right ventricle.

Oxygenated blood:

1. The oxygenated blood from the lungs is brought by pulmonary veins to left atrium.
2. The left atrium contracts and pumps this blood to the left ventricle.
3. The opening between left atrium and left ventricle is guarded (حفاظت کرتا ہے) by a valve known as **bicuspid valve**.
   Bicuspid valve is known as bicuspid because it has two flaps.

Human heart; structure and blood flow

4. When left ventricle contracts, it pumps the oxygenated blood in aorta, which carries

the blood to all parts of the body (except lungs).

5. The bicuspid valve prevents the backflow of blood from the left ventricle to the left atrium.
6. At the base of aorta, the aortic semilunar valve is present which prevents (روکتا ہے) the backflow of blood from aorta to the left ventricle.

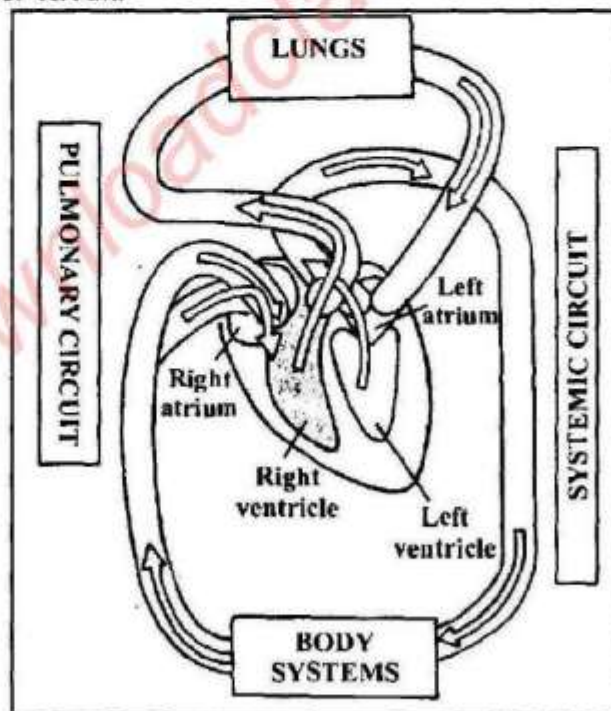
Conclusion:

The right side of the heart collects the deoxygenated blood from body and distributes (تقسیم کرتا ہے) it to the lungs while the left side collects the oxygenated blood (آکسیجن ملا خون) from lungs and distributes it to the body.

Pulmonary circulation:

The pathway on which deoxygenated blood (آکسیجن نکلا ہوا خون) is carried from the heart to the lungs and in return oxygenated blood is carried from the lungs to the heart is called pulmonary circulation or circuit.

Systemic circulation:

The pathway on which oxygenated blood is carried from heart to the body tissues and in return deoxygenated blood is carried from the body tissues to the heart is called systemic circulation or circuit.

Double circuit circulation of blood

Q.19. Write a note on heartbeat.

Ans: ***Heartbeat:***

One complete cardiac cycle makes one heartbeat.

Cardiac cycle:

The relaxation (پھیلنا) of heart chambers fills them with blood and contraction (سکڑنا) of chambers propels (دھکیلتا ہے) the blood out of them. The alternating relaxations and contractions make up the cardiac cycle.

Explanation:

The complete cardiac cycle consists of following steps.

1. ***Cardiac diastole:***

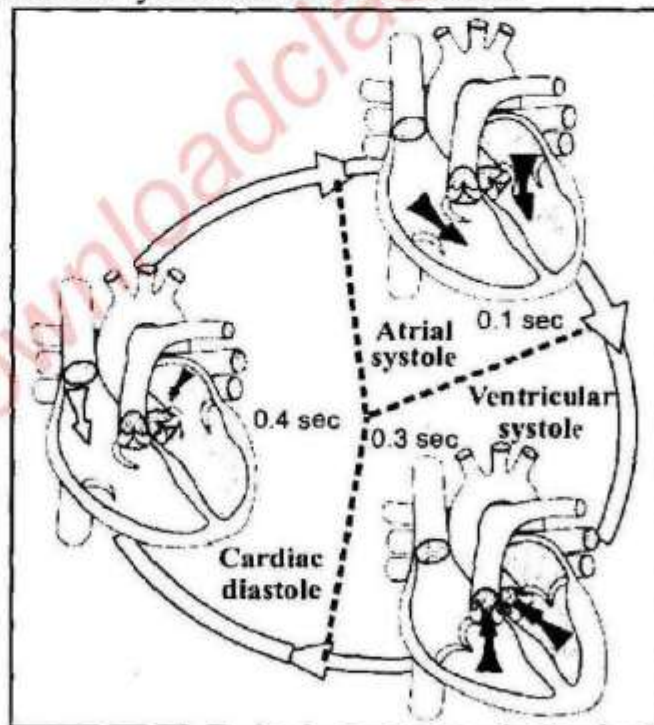
The atria and ventricles relax and blood is filled in atria. This period is called **cardiac diastole.**

2. ***Atrial systole:***

Immediately after their filling, both atria contract and pump the blood towards ventricles. This period in cardiac cycle is called **atrial systole.**

3. ***Ventricular systole:***

Now, both ventricles contract and pump the blood towards body and lungs. The period of ventricular contraction is called **ventricular systole.**

In one heartbeat, diastole lasts about 0.4 seconds, atrial systole takes about (تقریباً) 0.1 seconds, and the ventricular systole lasts about 0.3 second.

One cardiac cycle

Sound of heartbeat:

When ventricles contract, tricuspid and bicuspid valves close and "lubb" sound is produced. Similarly when ventricles relax, the semilunar valves close and "dubb" sound is produced. "Lubb-dubb" can be heard (سنی جا سکتی ہے) with the help of a stethoscope.

Q.20. What is the relation between heart rate and pulse rate?

Ans: ***Heart rate:***

The heart rate is the number of times the heart beats per minute.

A rest or during normal activities, the normal heart rate is 70 times per minute in men and 75 times per minute in women. The heart rate fluctuates (بدلتا رہتا ہے) a lot depending on factors such as activity level and stress level.

Measurement of heart rate:

The heart rate can be measured by feeling the pulse.

Pulse rate:

Pulse is the rhythmic expansion and contraction of an artery as blood is forced through it by the regular contractions of the heart.

The pulse can be felt at the areas where the artery is close (قریب) to the skin.

For example at the wrist (کلائی), neck, groin or top of the foot.

Most commonly, people measure their pulse in their wrist.

Q.21. Investigate the effect of physical activity on pulse rate.   *OR*
How is the pulse rate measured and how it is affected by various activities?

Ans: ***Pulse rate:***

The pulse rate (نبض کی رفتار) tells us the heart rate (دل کی رفتار).

As the heart pumps blood through the body, a pulsing can be felt in some of the blood vessels close to the skin's surface. Pulse rate is measured to see how well the heart is working.

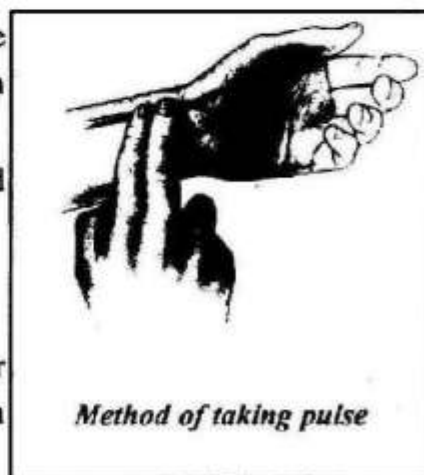
Background information:

⇒ The pulse rate increases when involved in some physical activity (جسمانی سرگرمی) i.e. physical exertion (مشقت) or exercise.

⇒ Daily physical exercise increases the stamina and strength of the cardio-vascular system.

Method of taking pulse

Procedure:

1. Turn the palm (ہتھیلی) side of your hand facing up.
2. Place your index and middle fingers of your opposite hand on your wrist, approximately 1 inch below the base of your hand.
3. Press your fingers down in the groove at this point. You should feel a throbbing (پھڑکن)-your pulse.
4. Count the number of beats for 10 seconds, then multiply (ضرب دیں) this number by 6.

This will give you your pulse rate per minute at resting condition.

5. Now do some physical exercise for example running in place (ایک جگہ دوڑنا), jumping jacks, or other exercise for one minute.
6. After the exercise, measure your pulse rate by the same method (step 1 to 4).
7. Sit on a chair and take rest. After about five minutes, take your pulse again and write it down.
8. Record the differences in the table form and compare your calculations with the differences counted by your class fellows.

Observations:

Student pulse rate at rest will vary (کم زیادہ) between 60-110 beats per minute. If the pulse rate at rest is about 70 times per minute, it may increase up to 100 beats per minute during exercise.

Evaluation:

(i) Are the heart rates of all students the same or different?

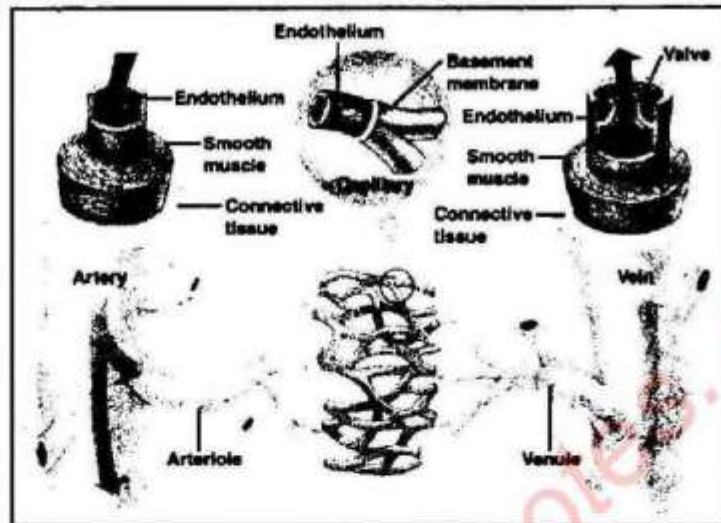
Ans. No, the heart rates of all students is not same. It is between 60-110 beats per minute, at rest.

(ii) What is the average heart rate of all the students?

Ans. Average (اوسط) heart rate of all the students is 70 times per minute.

Q.23. Compare the structure and function of arteries, veins and capillaries.

Ans: Comparison of structure and function of arteries, veins and capillaries.

Character-istics	*Arteries*	*Veins*	*Capillaries*
Function	Carry blood away from heart	Carry blood towards heart	Allow the exchange of materials between blood and tissues
Thickness and elasticity in walls	Thick and elastic	Thin and less elastic	One-cell thick, non-elastic walls.
Muscles in walls	Thick	Thin	No muscles
Blood pressure	High BP	Low BP	Medium
Valves	No valves	Valves present	No valves

Blood vessels

Q.24. Write a detail note on blood vessels (خون کی نالیاں). Write about their types, structures and functions.

Ans: Blood vessels are the part of blood circulatory system, which function to transport blood throughout body.

Important vessels:

The most important vessels in blood circulatory system are following.

1- Arteries 2- Capillaries 3- Veins

1. Arteries:

Function:

(i) Arteries are the blood vessels that carry blood away (دور) from heart.

(ii) In adults, all arteries with the exception of the pulmonary arteries, carry oxygenated blood.

Structure:

The structure of arteries is well adapted to their function.

The walls of an artery are composed of three layers.

The outermost (انتہائی بیرونی) layer is made of connective tissue.

The middle layer is made up of smooth (ہموار) muscles and elastic tissue.

The innermost (انتہائی اندرونی) layer is made up of endothelial cells.

Lumen:

The hollow internal cavity in which blood flows is called lumen.

Arterioles and capillaries:

When arteries enter body organs, they divide into smaller vessels known as arterioles. Arterioles enter tissues and divide into capillaries.

2. Capillaries:

Capillaries are the smallest blood vessels present in tissues.

These are formed by the division of arterioles.

Function:

The exchange of materials between blood and tissue fluid is carried out through capillaries.

Structure:

The walls of capillaries (عروق شعریہ) are composed of only a single layer of cells i.e. endothelium.

⇒ This layer is so thin that molecules of the digested food, oxygen and water etc. can pass through them and enter tissue fluid (ہضم شدہ خوراک).

⇒ Waste products such as CO_2 and urea can diffuse from tissue fluid into blood.

3. Veins:

Functions:

A vein is a blood vessel that carries blood towards heart.

⇒ In adults (بالغوں میں), all veins with the exception (سوائے) of pulmonary veins, carry deoxygenated blood.

Structure:

Veins are well-adapted to their function.

Walls of veins:

The walls of veins are composed of the same three layers as are present in the artery wall.

Middle layer of vein is comparatively thin and having less smooth and elastic tissue.

Lumen of vein:

The lumen of the veins is broader (چوڑا) than that of arteries.

Venules:

In a tissue, capillaries join to form small venules, which join to form veins.

Presence of valves:

Most veins have flaps called valves that prevent the backflow (واپس بہنا) of blood.

Q.25. How will you show the capillary flow in the tail or fins of a fish?

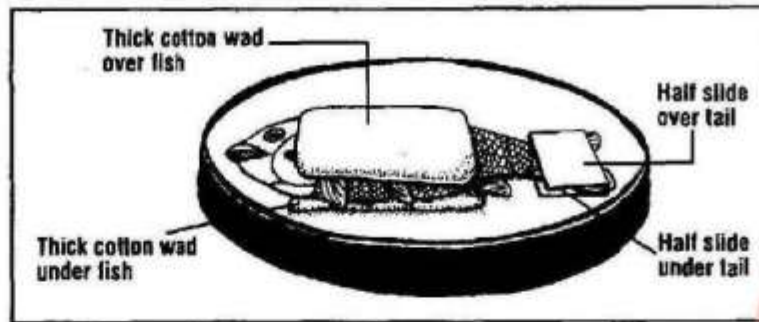
Ans: Capillaries:

Capillaries are the smallest blood vessels, which are formed by the divisions of arterioles.

Fishes possess a rich network of capillaries under their skin.

Experiment to show capillary flow in the tail or fins of a fish:

Procedure:

1. Set up the experiment according to the figure.

Experiment setup to show the capillary flow in fishtail

2. Place a thin wet wad of cotton on the bottom of a Petri dish towards one end.
3. Place a slide at the other end.
4. Remove a fish from the aquarium or jar of water and place it on the Petri dish such that its body lies over the wet cotton over fish and place another slide over the tail.
5. Remove the clips from the stage of microscope and place the Petri dish on the stage so that the tail of the fish is over the opening of the stage.
6. Focus the microscope on tail and adjust the part of the tail where blood capillaries are seen. Draw the structure of the capillary network seen in the tail of fish.

Q.26. Write a note an arterial system of man?

Ans: Arterial system:

The system of blood vessels through which oxygenated blood is supplied to all parts of body.

Explanation:

Pulmonary trunk:

Large **pulmonary trunk** emerges from the right ventricle and divides into right and left pulmonary arteries. Which carry the deoxygenated blood to the right and the left lungs.

Aorta:

The oxygenated blood leaving the left ventricle of the heart is carried in a large artery, the aorta.

Aortic arch:

The aorta ascends and forms an aortic arch.

Branches of aortic arch:

Three arteries emerge (نکلتی ہیں), which supply blood to head, shoulders and arms (بازو).

Dorsal aorta:

The aorta passes down through the thorax, it becomes the dorsal aorta.

Branches of dorsal aorta:

Dorsal aorta gives off many branches and the important ones are listed here.

Intercostal arteries:

Several intercostal arteries supply blood to the ribs.

Caeliac artery and the superior mesenteric artery

Caeliac artery and **superior mesenteric artery** supply blood to the digestive tract.

Hepatic artery

Hepatic artery supplies blood to the liver.

Renal arteries:

Inferior to hepatic artery there is a pair of renal arteries that supply blood to the kidneys (گردے).

Gonadal arteries:

The gonadal arteries supply the gonads.

Inferior mesenteric artery:

It serves the part of the large intestine and rectum.

Iliac arteries:

Aorta divides into two common iliac arteries.

(i) External (بیرونی) iliac artery (ii) Internal (اندرونی) iliac artery

Each external iliac artery becomes the femoral artery in the upper thigh. It gives balance to thigh, knee, shank, ankle and foot.

Q.27. Write a note on the venous system of man.

Ans: ***Pulmonary veins:***

Veins from lungs, called pulmonary veins return the oxygenated blood to the left atrium of heart.

Superior and Inferior vena cava:

These are the two major viens which carry deoxygenated blood from the rest of the body, and empty into the right atrium.

Superior vena cava:

Different veins from head, shoulders and arms join together to form superior vena cava.

Inferior vena cava:

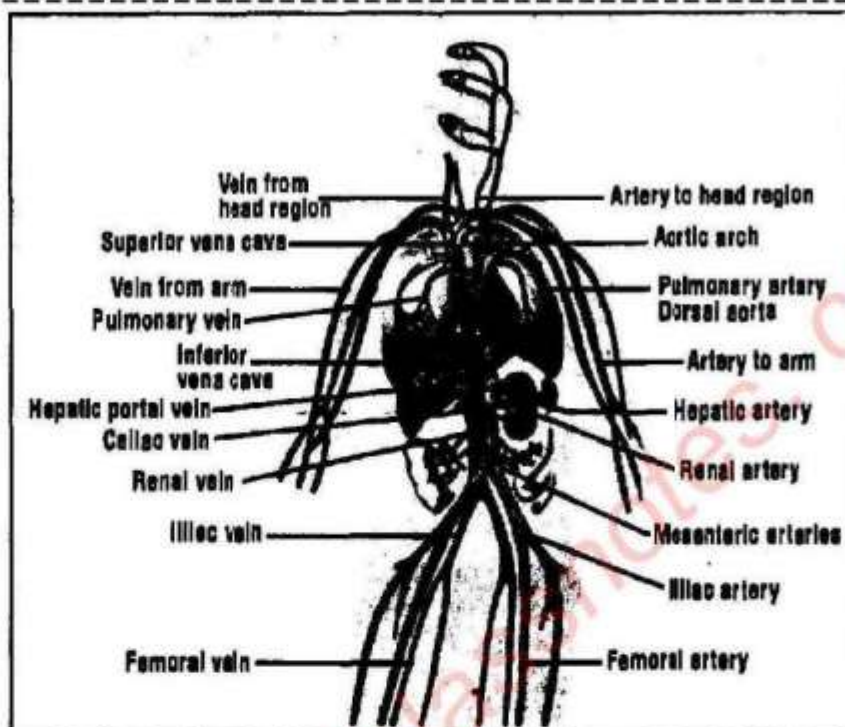
Deoxygenated blood collected from legs being many small veins join together and form inferior vena cava.

Femoral vein:

Veins carrying blood from calf (پنڈلی), foot and knee join together to form femoral vein.

Common iliac vein:

Femoral vein empties into the external iliac vein which joins with **internal iliac** and both empty into **common iliac vein**. The right and left common iliac veins join to form the inferior vena cava.

Many short veins empty into the inferior vena cava. i.e. hepatic, renal and the gonadal veins.

Major arteries and veins in human body

Veins coming from the stomach, spleen, pancreas, and intestine drain into the hepatic portal vein, which carries blood to the liver.

From liver, a hepatic vein carries blood and empties into the inferior vena cava.

Renal veins:

Two renal veins carry blood from the kidneys.

Gonadal veins:

Two gonadal veins carry blood from gonads to inferior vena cava.

In thoracic cavity, inferior vena cava also receives veins from thoracic walls and ribs.

9.3 Cardiovascular Disorders

Q.28. Write a short note on cardiovascular disorders.

Ans: ***Cardiovascular disorders***

The diseases that involve the heart or blood vessels (i.e. arteries and veins) are collectively called cardiovascular disorders.

Explanation:

Cardiovascular disorders have similar causes (وجوہات), mechanisms and treatments (علاج).

Risk factors:

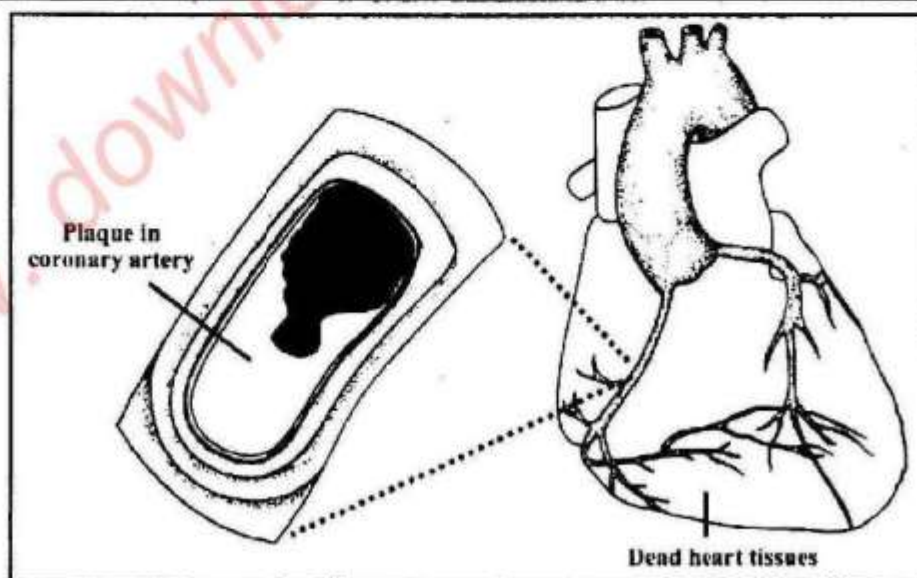
Risk factors which involve in cardiovascular disorders include.

(i) advanced age (زیادہ عمر)
(ii) diabetes (ذیابیطس)
(iii) high blood pressure (hypertension)
(iv) High blood concentration of low density lipids and triglycerides.
(v) tobacco smoking
(vi) obesity (موٹاپا)
(vii) sedentary (سست) lifestyle

Q.29. (a) How would you differentiate between atherosclerosis and arteriosclerosis?

(b) What is the prime contributor of atherosclerosis? How it results?

Ans: Atherosclerosis and arteriosclerosis are the diseases of arteries. These diseases also lead to heart disease.

Atherosclerosis	*Arteriosclerosis*
1. Arteries affecting disease commonly referred to as a "narrowing" of arteries.	1. Severe form of atherosclerosis
2. Accumulation of fatty materials, cholesterol or fibrin in arteries	2. Deposition of calcium in the wall of arteries.
3. Arteries can no longer expand and contract properly in severe cases and the blood moves through them with difficulty.	3. As it is a severe form of atherosclerosis, so have same symptoms

Ans. (b)

Accumulation (جمع ہونا) of cholesterol is the prime contributor to atherosclerosis. It results in the formation of multiple deposits called **plaques** with in arteries.

⇒ Plaques can form blood clots called thrombus within arteries. If a thrombus dislodges (علیحدہ ہو جاتا ہے) and becomes free-floating, it is called an embolus.

Q.30. State the causes, treatments and preventions of myocardial infarction.

Ans: ***Meaning of Myocardial infarction:***

Term myocardial infarction is derived from: myocardium = the heart muscle and infarction = tissue death.

Myocardial Infarction:

It is a medical condition that occurs when the blood supply to a part of the heart is interrupted (رکاوٹ) and leads the death of some cells of heart muscles.

Common name:

Myocardial infarction is commonly (عام طور پر) known as heart attack.

Causes:

Heart attack may be caused by blood clot in coronary arteries. It is a medical emergency, and the leading cause (بڑی وجہ) of death for both men and women all over the world.

Symptoms:

Severe chest pain is the most common symptom and is often described as a sensation of tightness (جکڑاؤ), pressure, or squeezing. Pain radiates most often to the left arm, but may also radiate to the lower jaw, neck, right arm, and back.

Loss of consciousness and even sudden death can occur in myocardial infarction.

Treatment:

Immediate treatment includes oxygen supply, aspirin and sublingual tablet of glyceryl trinitrate. Most cases of myocardial infarction are treated with angioplasty or bypass surgery.

Angioplasty:

It is a mechanical widening of a narrowed or totally obstructed (مکمل بند) blood vessel.

Bypass surgery:

It is a surgery in which arteries or veins from elsewhere in the patient's body are grafted to the coronary arteries to improve the blood supply to the heart muscles.

Myocardial Infarction in Pakistan:

According to a survey cardiovascular disorders are the cause of 12% of the adult deaths in Pakistan.

Hypertension (high blood pressure) is the most common cause of cardiovascular disorders in Pakistan and there are over 12 million (ایک کروڑ 20 لاکھ) hypertension patients in Pakistan

Prevention: Proper balanced diet (متوازن غذا) (low cholesterol) and regular daily exercise can prevent myocardial infarction and other cardiovascular diseases.

Review Questions

MULTIPLE CHOICE

1. **In most plants food is transported in the form of;**
   (a) Glucose (b) Sucrose (c) Starch (d) Proteins
2. **Stomata close when guard cells;**
   (a) Lose water (b) Gain chloride ions(c)Become turgid (d)Gain potassium ions
3. **Trace the pathway of water from soil through the plant to atmosphere.**
   (a) Endodermis, cortex, epidermis, xylem, intercellular spaces in mesophyll, stomata
   (b) Epidermis, endodermis, phloem, cortex of leaf, intercellular spaces of mesophyll, stomata
   (c) Root hairs, epidermis, cortex, xylem, endodermis, intercellular spaces in mesophyll, stomata
   (d) Root hairs, cortex, endodermis, xylem, intercellular spaces in mesophyll, stomata
4. **When fibrinogen makes blood clot, it separates from blood and the remainder is called:**
   (a) Plasma (b) Lymph (c) Serum (d) Puss
5. **What is correct about human red blood cells?**
   (a) Have limited life span (b) Are capable of phagocytosis
   (c) Produce antibodies (d) Are multinucleate
6. **Which of the following tissue layer is found in all blood vessels?**
   (a) Smooth muscle (b) Endothelium (c) Skeletal muscle (d)Connective tissue
7. **When do the atria contract?**
   (a) Before diastole (b) After systole (c) During diastole (d) During systole
8. **Which of the following contains deoxygenated blood in an adult human?**
   (a) Left atrium (b) Pulmonary artery (c) Pulmonary vein (d)All of the above
9. **Which of the following chambers has the thickest walls in human heart?**
   (a) Right atrium (b) Left atrium (c) Left ventricle (d) Right ventricle
10. **Which of these statements is correct about circulatory system?**
    (a) It transports hormones
    (b) Capillaries have thicker walls than veins
    (c) Systemic circulation carries blood to and from the lungs (d) All are true
11. **Exchange of materials between the blood and surrounding tissues occurs in;**
    (a) Arteries (b) Veins (c) Capillaries (d) All of the above
12. **Which of the following is a type of leukocytes?**
    (a) Lymphocyte (b) Eosinophil (c) Monocyte (d) All of the above

13. Which of the following is a function of human blood?
(a) It regulates body temperature (b) It transports wastes
(c) It provides defence (d) All of the above

14. Valves to prevent the backflow of blood are found in the;
(a) Arteries (b) Veins (c) Capillaries (d) All of the above

15. Plasma is made up of water and ________.
(a) Metabolites and wastes (b) Salts and ions
(c) Proteins (d) All of the above

16. Which of these are responsible for blood clotting?
(a) Platelets (b) Erythrocytes (c) Neutrophils (d) Basophils

17. Find the correct path of blood circulation?
(a) Left atrium, left ventricle, lungs, right atrium, right ventricle, body
(b) Right atrium, right ventricle, lungs, left atrium, left ventricle, body
(c) Left atrium, left ventricle, right atrium, right ventricle, lungs, body
(d) Right atrium, lungs, right ventricle, left atrium, body, left ventricle

18. A patient with blood group A can be given the blood of donor who has;
(a) Blood group A or AB (b) Blood group A or O
(c) Blood group A only (d) Blood group O only

19. The death of the heart tissue is called;
(a) Atherosclerosis (b) Arteriosclerosis
(c) Myocardial infarction (d) Thalassaemia

20. What happens when a mismatched blood group is injected in recipient?
(a) Antibodies of the recipient's blood destroy donor's RBCs
(b) Antibodies of the donor's blood breakdown recipient's RBCs
(c) Both of these can happen
(d) None of these happens and such transfusion can be safe

Ans: **1.** Sucrose **2.** Lose water
3. Root hairs, cortex, endodermis, xylem, intercellular spaces in mesophyll, stomata
4. Serum **5.** Have limited life span **6.** Endothelium
7. During systole **8.** Pulmonary artery **9.** Left atrium
10. It transports hormones **11.** Capillaries **12.** All of the above
13. All of the above **14.** Veins **15.** All of the above **16.** Platelets
17. Right atrium, right ventricle, lungs, left atrium, left ventricle, body
18. Blood group A or O **19.** Myocardial infarction
20. Both of these can happen

UNDERSTANDING THE CONCEPTS

1. ***How would you relate the internal structure of root with the uptake of water and salts?***

Ans: Refer to Q.No.3 for your answer.

2. **Define transpiration and relate it with cell surface and with stomatal opening and closing.**

Ans: Refer to Q.No.4 for your answer.

3. ***How do different factors affect the rate of transpiration?***

Ans: Refer to Q.No.5 for your answer.

4. ***Transpiration is a necessary evil. Give comments.***

Ans: Refer to Q.No.6 for your answer.

5. ***Explain the movement of water in terms of transpirational pull.***

Ans: Refer to Q.No.10 for your answer.

6. ***Describe the theory of pressure flow mechanism to explain the translocation of food in plants.***

Ans: Refer to Q.No.11 for your answer.

7. ***List the functions of the components of blood.***

Ans: Refer to Q.No.13 for your answer.

8. ***How do we classify blood groups in terms of the ABO and the Rh blood group systems?***

Ans: Refer to Q.No.15 for your answer.

9. ***State the signs and symptoms, causes and treatments of leukemia and thallassemia.***

Ans: Refer to Q.No.14 for your answer.

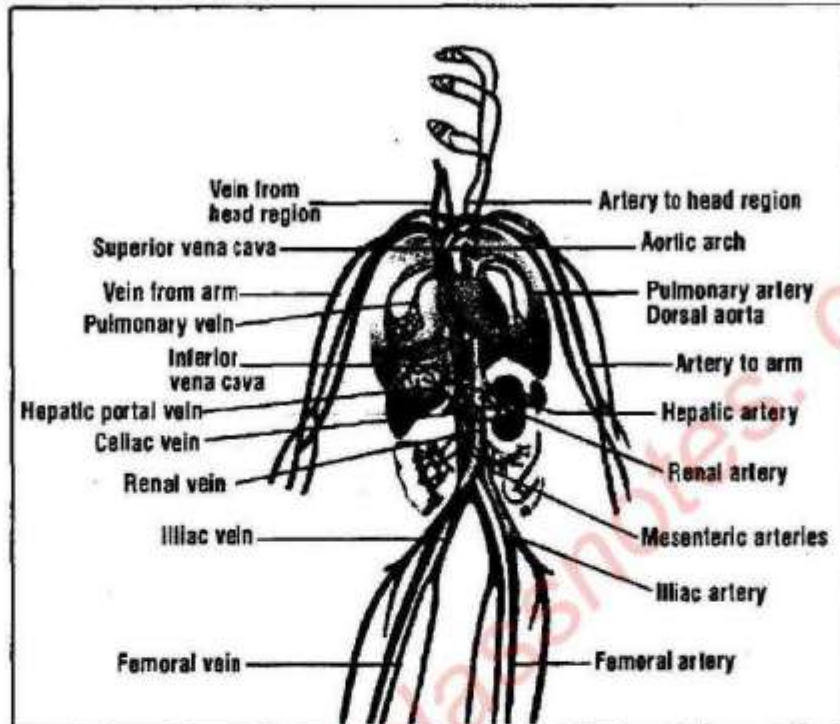
10. ***What four chambers make the human heart and how blood flows through these chambers?***

Ans: Refer to Q.No.18 for your answer.

11. ***Compare the structure and function of an artery, a vein and a capillary.***

Ans: Refer to Q.No.23 for your answer.

12. ***Draw diagrams which can illustrate the origins, locations and targets areas of the main arteries in human blood circulatory system.***

Ans:

13. ***Draw diagrams which can illustrate the areas and locations of the main veins in human blood circulatory system.***

Ans: See q # 12 of exercise

14. ***How would you differentiate between atherosclerosis and arteriosclerosis?***

Ans: Refer to Q.No.29 for your answer.

15. ***State the causes, treatments and prevention of Myocardial infarction.***

Ans: Refer to Q.No.30 for your answer.

SHORT QUESTIONS

1. ***What are lenticels and where are they found in plant body?***

Ans: Lenticels are small opening for the loss of water, present in the stems of some plants.

2. ***What is the role of potassium ions in the opening of stomata?***

Ans: The light causes the movement of potassium ions from epidermal cells into guard cells. Water follows these ions and enters guard cells. Thus their turgidity increases and stoma open.

3. ***Define the cohesion-tension theory.***

Ans: According to this theory, the force which carries water upward through the xylem is transpiration pull. Transpiration creates a pressure difference that pulls water and

salts up from roots.

4. *What do you mean by sources and sinks according to the pressure flow mechanism?*

Ans: Sources include the exporting organs, typically a mature leaf or storage organ.

Sinks are the areas of active metabolism or storage e.g. roots, tubers, developing fruits and leaves and growing regions.

5. *What are the two main types of white blood cell? How do they differ?*

Ans: There two main types of WBCs.

Granulocytes have granular cytoplasm. These include **neutrophils** (destroy small particles by phagocytosis), **eosinophils** (break inflammatory substances and kill parasites) and basophils (prevent blood clotting).

Agranulocytes have clear cytoplasm and include **monocytes** (produce macrophages which engulf germs) and **B and T lymphocytes** (produce antibodies and kill germs).

6. *You see pus at the site of infection on your skin. How is it formed?*

Ans: WBCs die in the process of killing the germs. These dead cells accumulate and make the white substance called pus, seen at infection sites.

7. *What role does the pericardial fluid play?*

Ans: Pericardial fluid reduces friction between pericardium and heart, during heart contractions.

8. *Define the terms systole and diastole.*

Ans: ***Systole:*** After the filling of atria, both atria contract and pump blood towards ventricles. This is called systole.

Diastole: Atria and ventricles relax and blood is filled in atria this period is called diastole.

THE TERMS TO KNOW

ABO system:

System in which there are four different blood groups which are distinct from each other on the basis of specific antigens (antigen A and B) present on the surface of RBCs.

Agglutination:

Clumping of blood cells is called agglutination.

Agranulocytes:

These are the leukocytes with clear cytoplasm. These include monocytes and lymphocytes, formed in the lymphoid tissue of lymphatic system.

Albumin:

A protein without a prosthetic group is called albumin.

Angina pectoris:

It means chest pain occurs for reasons similar of those which cause heart attack.

Anti-A antibody:

A protein produced by lymphocytes that attack antigen, present in blood group B.

Anti-B antibody:

A protein produced by lymphocytes that attack antigen, present in blood group A.

Antigen:

Foreign invaders in the body that triggers an immune response.

Antigen A:

Antigen that present on the surface of RBCs of blood group A, triggers an immune response.

Antigen B:

Antigen that present on the surface of RBCs of blood group B, triggers an immune response.

Anti-Rh antibody:

An antibody against any Rh antigen, it must be required and is never natural.

Aorta:

Blood vessel through which oxygenated blood leaves the human heart.

Aortic arch:

Aorta ascends to form an aortic arch, arteries emerging from aortic arch supply blood to head, shoulders and arms.

Arteriole:

Arteries divide into smaller vessels known as arteriole.

Arteriosclerosis:

Term describing any hardening of arteries.

Artery:

Blood vessel which carry blood away from the heart.

Atherosclerosis:

Disease which referred to as a narrowing of the arteries due to any accumulation of fatty material, abnormal amounts of smooth muscles, cholesterol or fibrin.

Atrial systole:

The period in which both atria contract and pump the blood towards ventricles, called atrial systole.

Atrium:

Upper thin-walled chamber of heart is called atrium.

B lymphocytes:

Lymphocytes which recognize antigens and synthesize antibodies against them.

Basophils:

Leukocytes which prevent blood clotting.

Bicuspid valve:

Value with two flaps, present between the opening of left atrium and left ventricle.

Blood group systems:

Classification of blood based on the presence or absence of antigens on the surface of red blood cells.

Capillary:

These are the smallest blood vessels which are formed by the divisions of arteriole.

Cardiac cycle:

The alternating relaxations and contractions make up the cardiac cycle.

Cardiovascular system:

The system consisting of the heart, blood vessels and the blood that circulates throughout the body delivers essential materials to cells and removes waste products called cardiovascular system.

Cohesion-tension theory:

According to this theory, the mechanism by which water is carried upward through the xylem is transpirational pull.

Coronary artery:

The artery which supplies blood to the heart muscles is called coronary artery.

Cortex:

External layer of plant's root consisting of broad zone of large, thin-walled cells.

Diastole:

Atria and ventricles relax and blood is filled in atria is called diastole.

Dorsal aorta:

As aorta passes down through thorax, it becomes dorsal aorta.

Embolus:

An obstruction in a blood vessel, usually a lodged blood clot.

Endodermis:

A single layer of cells which surrounds the pericycle layer.

Eosinophils:

A type of leukocytes that provide defense against parasites.

Erythrocytes:

These are a type of blood cell having biconcave shape. These are filled with hemoglobin. These also known as red blood cell.

Fibrin:

An elastic, insoluble, whitish protein produced by the action of thrombin on fibrinogen.

Fibrinogen:

A protein in the blood plasma that is essential for the coagulation of blood.

Granulocytes:

These are the leukocytes with granular cytoplasm these include neutrophils, eosinophils, and besophils.

Guard cell:

On of the paired epidermal cells that control the opening and closing of a stoma in plant tissue.

Haemoglobin:

The iron containing respiratory pigment in red blood cells of vertebrates, consisting of about 6% haem and 94% globin.

Heart rate:

It is the number of times the heart beats per minute.

Lenticels:

One of the small, corky pores or narrow lines on the surface of stems of woody plants that allow the interchange of gases between the interior tissue and the surrounding air.

Leucocytes:

These are colourless blood cells. They are not confined to blood stream, as they migrate out the tissue fluid, also called as white blood cells.

Leukaemia:

It is characterized by the appearance of great number of immature and abnormal white blood cell in the bone marrow and often in the spleen and liver.

Lymphocytes:

These are major component of immune system with large nucleus which fills almost all of cytoplasm. They are 32% of leukocytes. Their types or B. lymphocytes and T lymphocytes.

Lymphogenous cells:

Cells which produce lymph or cells in the lymphatics.

Megakaryocytes:

They are not cells, but are fragments of large cells of bone marrow.

Monocytes:

These are types of WBCs and produce macrophages which engulf germs.

Myocardial Infarction:

Commonly known as heart attack, medical condition that occurs when the blood supply to a part of the heart is interrupted and leads the death of some calls of heart muscles.

Neutrophils:

Leukocytes which destroy small particles by phagocytosis.

Pericardial fluid:

The fluid in the pericardial cavity.

Pericardium:

Heart is enclosed in a sac called pericardium.

Pericycle:

A plant tissue characteristic of the roots, located between the endodermis and phloem.

Phloem:

Compound tissue through which food is transported in a plant.

Plasma:

Plasma is primarily water in which proteins, salts, metabolites and wastes are dissolved.

Platelets:

They are not cells, but are fragments of large cells of bone marrow, called megakaryocytes. These help in blood clotting.

Pulmonary artery:

The artery that carries deoxygenated blood from right ventricle to the lungs for oxygenation.

Pulmonary circulation:

The circulation of the blood through the lungs for the purpose of oxygenation and the release of carbon dioxide.

Pulmonary vein:

A vein that carries oxygenated blood from the lungs to the left atrium of the heart.

Pulse:

It is the rhythmic expansion and contraction of an artery as blood is forced through

it by the regular contractions of the heart.

Red blood cells:

A cell in the blood of vertebrates that transports oxygen and carbon dioxide from and to the tissues.

In mammals, the red blood cells are biconcave, contains hemoglobin and lacks a nucleus, also called erythrocytes.

Rh factors:

Any of several substances on the surface of red blood cells that induce a strong antigenic response in individuals lacking the substance.

Rh-blood group system:

In this system, there are two blood groups i.e. Rh-positive and Rh-negative, which are distinct from each other an the basis of antigens called Rh factors present on the surface of RBCs.

Root hair:

A thin hair like outgrowth of an epidermal cell of a plant root that absorbs water and minerals from the soil.

Semilunar valve:

Valve which prevents backflow of blood from pulmonary trunk to the right ventricle.

Stoma:

Singular of stomata, present on the surface of leaves, through which transpiration takes place.

Systemic circulation:

Pathway on which oxygenated blood is carried from the heart to the body tissues and in return deoxygenated blood is carried from the body tissues to the heart is called systemic circulation.

T lymphocytes:

The recognize antigens and then combat them in different ways.

Thalassaemia:

Also known as cooley's anemia in this disease normal hemoglobin is absent, characterized by severe anemia, enlargement of heart, liver and spleen and skeletal deformation.

Thrombocytes:

These are not cells, but are fragments of large cells of bone marrow called

megakaryocytes. These help in blood clotting.

Thrombus:

A blood clot in a blood vessel (severe form of plaque) that remains at the point of its formation.

Transpiration:

Loss of water from the plant surface through evaporation.

Transpirational pull:

Mechanism by which water along with dissolved materials is carried upward through the xylem is called transpirational pull.

Tricuspid valve:

Valve present the opening between the right atrium and right ventricle, guarded by tricuspid valve (because it has three flaps)

Vein:

A blood vessel that carries blood towards the heart i.e deoxygenated blood.

Vena cava:

These are two large veins, called superior and inferior vena cava. Vena cava collects deoxygenated blood from whole body and pass it to right atrium of heart.

Ventricle:

Lower thick walled chamber of heart called ventricle. Two ventricles are present in human heart, right and left ventricle.

Ventricular systole:

The period of ventricular contractions is called ventricular systole.

Venule:

Veins divide into smaller vessels called venules.

White blood cells:

These blood cells are colourless, they are not confined to blood vessels they are much larger than (two or three times) the red blood cells.

Wilting:

Plant or its parts become limp or flaccid. This condition is called wilting.

Xylem:

Compound tissues which transports water and minerals up a plant.

ACTIVITIES

1. Observe root hairs on a growing root of onion, carrot etc.
2. Describe the structure and number of stomata after microscopic observation of an epidermal peel of a leaf.
3. Investigate the rate of water loss at the two surfaces of a leaf by a simple

experiment using cobalt chloride paper.

4. Investigate transpiration in potted plant under a bell jar.
5. Identify xylem and phloem tissues in the prepared slides of stem, root and leaf.
6. Investigate the pathway of water in a cut stem, using a suitable stain.
7. Identify red and white blood cells under the light microscope on prepared slides and in diagrams and photomicrographs.
8. Investigate the effect of physical activity on pulse rate.
9. Show the capillary flow in a fishtail or fin or frog's web.

SCIENCE, TECHNOLOGY AND SOCIETY

1. State vascular surgery as one of the major fields in the careers.

Ans. Vascular surgery is a field in surgery in which diseases of arteries and new (like thrombosis etc) are managed by surgical methods.

A vascular surgeon treats the diseases of all parts of the vascular system except that of the heart and brain.

As cardio vascular diseases are increasing day by day, so vascular surgery is becoming a major fields in the carress.

2. Identify that cardiovascular disorders are the major cause of sudden non-accidental deaths.

Ans. Cardiovascular disorders:

The diseases that involve the heart or blood vessels are collectively called cardiovascular disorders.

These diseases are the major cause of sudden non-accidental deaths. The some types of cardiovascular diseases are as follows.

(i) Angina pectoris (ii) Atherosclerosis (iii) Myocardial infarction
(iv) Coronary artery diseases (v) Heart failure

(i) Angina pectoris:

It is chest pain. The pain may occur in heart and often in left arm and shoulder. It is a warning sign that the blood supply to the heart muscles is not sufficient but the shortage is not enough to cause tissue death.

(ii) Atherosclerosis:

In this disease there is a accumulation of fatty materials, abnormal amounts of smooth muscles, cholesterol, or fibrin in the arteries.

(iii) Myocardial infarction:

Commonly known as heart attack. It occurs when the blood supply to a part of the heart is interrupted and leads the death of some cells of heart muscles.

(iv) Coronary artery diseases:

Coronary artery supplies blood to the heart. If there is some blood clot, it will cause heart attack.

(v) Heart failure:

These are many factors of heart failure. It includes marrowing of the arteries of some blockage in the valve. These affect the functioning of heart and in result blood supply to the body is affected and cause death of patient.

3. Explain the social as well as personal factors that contribute to cardiovascular disorders in Paksitan.

Ans. According to a survey cardiovascular disorders were reported as the cause of 12% of the adult deaths in Pakistan (Source: Federal Bureau of Statistics of Pakistan)
Factors causing vascular diseases are as follows.

(i) Hypertension (ii) Smoking
(iii) High cholesterol level (iv) Lack of interest in exercise (sedentary lifestyle)
(v) Obesity (vi) Diabetes
(vii) Personal tensions and poverty (viii) Heredity (ix) Eating Habits

(i) Hypertension:

Hypertension is the most common risk factor of cardio vascular disorders in Pakistan, and these are 12 million hypertension patients in Pakistan. Further move 85% of patients in rural areas are unaware of their hypertension.

(ii) Smoking:

Smoking is becoming very common among males in Pakistan, which causes heart attack.

(iii) High cholesterol level:

High cholesterol level is also a major factor of heart diseases in Pakistan. It forms layers in the blood vessels which cause hindrance in passing blood through them, which leads to heart attack.

(iv) Sedentary lifestyle:

People take food that contain energy more than their requirement and no physical exercise cause also heart disease.

(v) Obesity:

Obesity is also one of the cause of heart attacks in Pakistan. It is more in women than men. Every one of ten person is suffering from obesity.

(vi) Diabetes:

Diabetes also causes heart problems. Pakistan is among the top 10 world nations for high numbers of people with diabetes. About 10% of our population is diabetic.

(vii) Personal tensions and poverty:

It is also one of the major reasons of cardiovascular diseases. Poverty is very common in Pakistan. About 70% people are victim of it. People have less income than their expanses.

(viii) Heredity:

Heredity is also one of the major reason of heart diseases. Some people adopt this disease from their parents.

(ix) Eating Habits:

Eating habits also cause heart attacks. Spicy and high cholesterol food with high calories is more common. In Pakistan fast food restaurants have changed the country's eating pattern. More over, there is a greater tendency to snack between meals. Such behavior is more common among young people.

ON-LINE LEARNING

- waynesword.palomar.edu/aniblood
- en.wikipedia.org/wiki/Circulatory_system
- www.fi.edu/learn/heart/systems/circulation.html
- www.sparknotes.com/biology/plants/essentialprocesses/
- http://highered.mcgraw-hill.com/

OBJECTIVE TYPE QUESTIONS (MCQ'S+SHORT ANSWERS) FROM PREVIOUS ANNUAL PAPERS OF ALL SECONDARY BOARDS
(LAHORE, GUJRANWALA, FAISALABAD, MULTAN, SAHIWAL, SARGODHA, RAWALPINDI, D.G. KHAN, BAHAWALPUR)

☆ **Tick the correct answer.**

1. **In one heart beat, diastole remains about seconds:** **(LHR. GI)**
   (A) 0.6 (B) 0.8 (C) 0.4 (D) 0.7
2. **"Lub dubb" can be heard with the help of:** **(LHR. GII)**
   (A) Stethoscope (B) Telescope (C) Microscope (D) Sound Box
3. **When does our heart rest?** **(GRW. GI)**
   (A) at night (B) during sitting (C) never (D) during sleep
4. **Transpiration rate depends upon:** **(GRW. GII)**
   (A) leaf surface area (B) water content (C) temperature (D) all of these
5. **Cardiac muscles are present in wall of:** **(FBD. GI)**
   (A) Heart (B) Lungs (C) Kidney (D) Stomach
6. **Which part of plant is responsible for transporting food?** **(FBD. GI, GRW. GI)**
   (A) Xylem (B) Phloem (C) Root (D) Leaf